BEFORE THE MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

AN APPLICATION FOR A PERMIT TO SITE A MAJOR FACILITY:

A 100-KV TRANSMISSION LINE FROM GLENGARRY TO JUDITH GAP AND ASSOCIATED SUBSTATION FACILITIES, CENTRAL MONTANA

VOLUME 1: PERMIT APPLICATION

THE MONTANA POWER COMPANY
40 EAST BROADWAY
BUTTE, MONTANA 59701

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SECTION 1:
NATURE OF THE APPLICATION

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1.1 Purpose of the Applicant

The Montana Power Company (the Applicant) submits this application to the Montana Department of Natural Resources and Conservation (DNRC), acting as agent for the State of Montana, to satisfy the requirements of the Montana Major Facility Siting Act. This application is for a permit to construct a new transmission line and associated substation facilities in the Central Montana Area. For the purpose of this application, the Central Montana Area incorporates the geographic region bounded by the towns of Harlowton to the southwest, Stanford to the northwest, Grassrange to the northeast, and Roundup to the southeast.

1.2 Structure of the Application

This application is presented in three volumes. Volume I details the Applicant's permit application including the basis of the need, the proposed solution, alternative solutions investigated but rejected, a technical description of the proposed facility, and the transmission line siting analyses. Volume II contains resource maps used by the Applicant in Phases I and II of its siting analyses, and Volume III contains detailed technical data in support of the application. In addition, a series of supplemental reports are submitted which contain supporting data obtained by the Applicant through technical consultants.

Volume I, the formal application, is structured on the basis of first defining the situation which has prompted the Applicant to seek a permit, a statement of the Applicant's proposed solution, and supporting data for the decision. Next, a technical description of the transmission line is provided. The application then defines the preferred route selected by the Applicant and describes the technical approach used to reach that decision.

Throughout the application, highly technical data are relegated to a separate volume (Volume III). The Applicant believes this format will facilitate the review process. The technical terms used throughout the application are defined in Section 1.3.

One copy only of Volume III is submitted, since this volume is of primary interest and use to the regulatory agency. Only three copies of the cultural resources map are submitted, one to the State Historic Preservation Office (SHPO) and two to DNRC, since disclosure of the data could lead to destruction of those unique resources; this document is exempt under the Freedom of Information Act [U.S.C. 552(6)].

1.3 Definition of Technical Terms

Normal Operating Condition: The condition under which no transmission lines are out of service (except for transmission lines which are normally out of service) and all generation is producing power (except for generation which is normally out of service).

Single Contingency Outage: The condition under which one transmission line normally serving a location is out of service.

Radial Transmission Line: A transmission line which only has one source of power available (at one end only).

Loop Service: A transmission line which has more than one source of power available, or a substation which has more than one source of power available.

System Normal Voltage: The voltage calculated or measured at a specific location for a specific load condition, during normal operating conditions.

System Short-Term Voltage Variation: Changes in the system normal voltage which are of short duration (less than five seconds) and are caused by changes in the electrical power system.

Calculated Voltage: The voltage which is calculated from engineering equations at a specific location for a specific load condition.

Corona Loss: A luminous discharge due to ionization of the air surrounding a conductor when the voltage gradient exceeds a certain critical value (definition by the Institute of Electrical and Electronic Engineers).

Centerline: The precise location of a transmission line (see "route").

Reference Centerline: A tentative centerline used in comparing and evaluating alternative routes after the baseline study; a route is defined in terms of the reference centerline (see "route").

Route: A linear strip of land extending a specified distance, usually one mile, on either side of the reference centerline.

Study Area: An area including the proposed and alternative end points of a facility and all land area between the end points.

Study Corridor: A linear strip of land of variable width (generally five to 25 miles) within the study area which excludes portions of the study area that must be avoided because they are protected by special legislation (such as wilderness areas), and which is generally suitable for transmission line location (including one or more routes).

Candidate Corridors: Study corridors retained for further analysis after completion of a preliminary comparison of study corridors.

1.4 The Existing System

The existing Central Montana Area electrical transmission system is mapped in Figure 1.4-1 (some minor lines have been deleted to enhance clarity). The system includes the following:

1. A 100-kV transmission line from Harlowton to Stanford with a radial 100-kV tap at Benchland extending to the Glengarry Substation;

2. A 50-kV transmission line connecting the Harlowton Substation to the Glengarry Substation and the Glengarry Substation to the Stanford Substation;

3. Transformer facilities at Stanford, Glengarry, and Harlowton substations which electrically connect the 100-kV transmission system to the 50-kV transmission system;

4. Two 50-kV transmission lines connecting Lewistown and the Glengarry substations; and

5. Two radial 50-kV transmission lines extending from Lewistown to the Heath Substation (U.S. Gypsum) and the Hilger-Winifred areas. (The latter 50-kV line is owned by the Applicant from Lewistown to a point approximately 12 miles north of Lewistown; the remainder of the line is owned by Fergus Electric Coop.)

A 230-kV transmission line traverses the Central Montana Area from the Broadview switchyard to Great Falls, but is not electrically connected to the Central Montana Area system.

A one-line diagram of the existing transmission system is contained in Volume III as Exhibit A.

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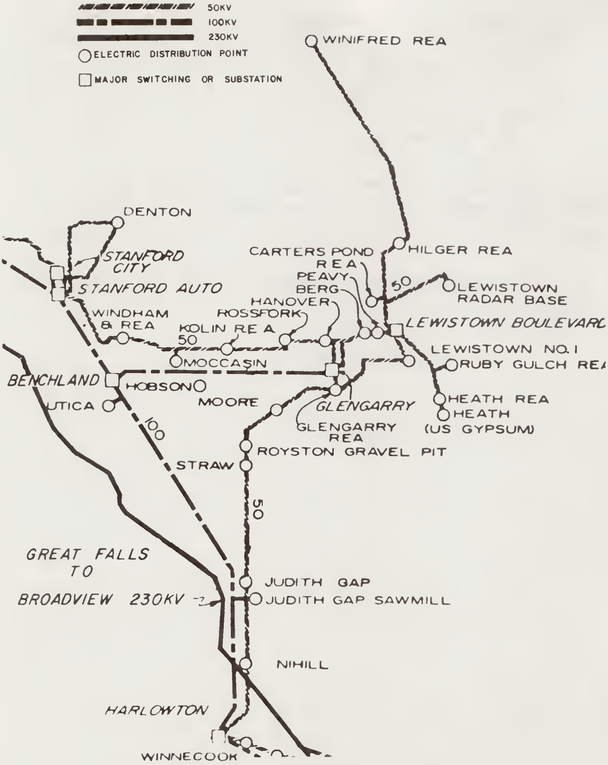

Figure 1.4-1. Existing Transmission System in the Central Montana Area.

SECTION 2:
ESTABLISHMENT OF NEED AND PROPOSED SOLUTION

Statement of Need

Explanation of Need
Power Transfer Capability and Voltage
Reliability
Transient Stability

Supporting Data
Load Growth
Population Growth

Proposed Solution

2.1 Statement of Need

The major existing problem on the Central Montana Area system which requires solution is unacceptable voltage levels under single contingency outages. Further, projected load growth indicates unacceptable voltage levels will occur under normal operating conditions by 1984.

The existing transmission facilities have calculated voltage levels which are acceptable during existing normal operating conditions and current heavy load levels. However, during a single contingency outage, usually on the Benchland-to-Glengarry 100-kV line, calculated voltages on the system drop to unacceptable levels. Table 2.1-1 shows calculated voltage levels under both normal and outage conditions. The load flow studies summarized in this table are included in Exhibit B (Volume III).

Table 2.1-2 summarizes projected percent voltage under normal and outage conditions on the Central Montana system for the winter of 1984. The load levels in the area are projected to increase to the point where calculated voltages will drop to unacceptable levels during normal operating conditions, and to very low levels during a single contingency outage on the Benchland-to-Glengarry 100-kV transmission line. These results are summarized in Table 2.1-2; supporting material in Exhibit B (Volume III) details the Applicant's load flow studies used in these projections.

Table 2.1-1. Percent Voltage Under Normal and Outage Conditions, Winter 1981.

LOCATION	NORMAL OPERATING CONDITIONS	OUTAGE CONDITIONS
Stanford 100-kV	98.4	--[a]
Benchland 100-kV	97.6	
Harlowton 100-kV	99.9	
Glengarry 100-kV	93.5	
Glengarry 50-kV	97.8	
Lewistown 50-kV	93.9	
Lewistown Radar Base 50-kV	92.0	

[a] Voltage levels cannot be calculated. Because voltage levels are so low, computer solutions are meaningless.

Table 2.1-2. Projected Percent Voltage Under Normal Operating and Outage Conditions, Winter 1984.

LOCATION	NORMAL OPERATING CONDITIONS	OUTAGE CONDITIONS
Stanford 100-kV	96.9	--[a]
Benchland 100-kV	96.0	
Harlowton 100-kV	99.1	
Glengarry 100-kV	91.3	
Glengarry 50-kV	92.8	
Lewistown 50-kV	88.2	
Lewistown Radar Base 50-kV	86.0	

[a] Voltage levels cannot be calculated. Because voltage levels are so low, computer solutions are meaningless.

2.2 Explanation of Need

2.2.1 Power Transfer Capability and Voltage

The amount of power delivered over a transmission system can be limited in two ways: 1) the power transfer capability of a piece of equipment, and 2) the voltage levels at different points during different load conditions. Power transfer or capacity of a piece of equipment is the amount of apparent power (megavolt-amps) which can be transmitted through the equipment without destroying or drastically shortening the life of the equipment. In addition, each piece of electrical equipment has a voltage rating (nameplate rating) at which it can operate without being damaged.

Reality dictates that voltage drops occur in the transmission and distribution systems and customer service lines which cause every piece of electrical equipment to be subjected to voltages which are not at the exact nameplate rating. To operate a utility system in such a manner as to have each piece of electrical equipment subjected to nameplate voltage rating, or to have manufacturers have each piece of equipment built to operate at voltages quite different from the nameplate rating, would be economically impossible. Instead, a compromise is made between how much the utility voltage levels can vary and how much the electrical equipment is built to handle.

The Applicant designs and operates its transmission systems under several guidelines set forth by law and accepted engineering practice. The Montana Public Service Commission has established the standards listed in Table 2.2-1; industry standards (ANSI) appear in Exhibit C (Volume III). These standards do not cover short-term variations caused by the elements, motor starting or utility short-term voltage

variations, which are beyond the control of the utility. The Applicant uses a +5 or -10 percent voltage fluctuation for the voltage criteria on its transmission system.

Table 2.2-1. Voltage Level Standards by Customer Type.

CUSTOMER TYPE	VOLTAGE VARIATION ABOUT NOMINAL
Residential or Commercial	
(2,500 People or More)	+ or - 6 Percent
(Less Than 2,500 People)	+ or - 8 Percent
Power Purposes	
(Power Rate Schedules)	+ or - 10 Percent

SOURCE: Rule 8-5, Electric Service Regulations and Schedules Prescribed by Public Service Commission of Montana for The Montana Power Company, 1961.

2.2.2 Reliability

In order to solve voltage variation problems during transmission loss and generation loss, loop service is provided where major generation and transmission substations exist. In providing a loop service or multiple transmission line network, accepted engineering practice dictates that voltage levels should not fall below the standards described in Table 2.2-1 for a line out of service. This implies that during normal system operation the voltage levels on the transmission system should not fall below 90 percent except for very short periods of time. Where two or more transmission lines connect to one substation, good engineering practice dictates that the voltage levels at the substation should not vary more than +5 or -10 percent for an outage on any one of the lines. This practice determines the reliability of the system for single contingency outages. Transmission line outages in this case may be only seconds in length (lightning strikes) or several days (severe ice or wind damage) depending on the severity of the problem.

At this time, a problem exists when the Benchland-to-Glengarry 100-kV line is out of service because the existing 50-kV system cannot support the Central Montana loads. Listed in Exhibit D (Volume III) is a historical record of the last two years of outages logged in the Central Montana Area by the Applicant.

2.2.3 Transient Stability

Transient stability was not a consideration in the application and therefore is not discussed.

2.3 Supporting Data

2.3.1 Load Growth

Projected load growth data are based on an exponential least square curve fit to historical substation demand loads. This method of load projection is used for projecting short-term needs in a small geographic area. The Applicant uses more sophisticated methods for its company-wide long-range forecasts, but such methods are not practical for short-term, individual substation load forecasts. The historical load data were obtained for individual substations by metering monthly peak demands (kilowatts). Winter peak demand load data cover four months beginning with November and extending through February of the following year. The summer peak demand load data cover three months, beginning with June and ending in August. These data are stored in a computer data base.

A computer program uses the peak demand load data base and, with an exponential least squares curve fit, determines a compound growth rate for each substation. The program also projects the load into the future for any desired period of time. Block load additions or subtractions can be used to

modify or represent large load changes or substation load transfers in the load data groups. This mainly creates a step function change in the fitted curve and only slightly changes the actual growth rate computed. A summary of the individual substation peak load data is provided in Exhibit E (Volume III).

Kilowatt hour consumption load data are listed in Exhibit F. Three customer classes (Residential, Commercial and Industrial) are listed for each town in the Central Montana Area. Growth projections for the residential customer class are provided in the same Exhibit F, by using the exponential least squares curve fit described previously. Total residential kilowatt hour consumption growth projections for all of the towns in the Central Montana Area are contained in Exhibit F (Volume III). This load growth calculation yields a growth rate of approximately two percent for the study area. This figure compares to a company-wide total sales forecast of 2.4 to 3.4 percent growth derived by more sophisticated econometric modelling (see Section 3.1.1.2.2). Population data compiled in the Section 2.3.2 show the population in the study area has increased by about 1.5 percent over the last ten years.

Load duration curves for Glengarry, Harlowton and Stanford 100/50-kV transformers are provided in Exhibit G (Volume III). These curves provide information of the duration and the level of loads in the Central Montana Area experienced during 1981. For example, the Glengarry 100/50 transformer had a peak load of 14.2 megawatts and an average load of 7.5 megawatts. Approximately 19 percent of the time (1,664 hours), the load is at 60 percent (10.4 megawatts) or higher. A load duration curve for the entire Central Montana Area provides an idea of the duration and the levels of loads experienced for the entire area. The

peak load level was 33.8 megawatts with a load factor of 51 percent during 1981.

The load duration curves are calculated and plotted by a computer program. Load levels are stored in a computer data base and are compiled by taking periodic readings from recording watt charts on the substation. The program then determines the total number of hours (period length), peak demand, and the percentage of time the load is at a specific level. The program can then calculate the load factor, average kilowatts, and the total energy in kilowatt hours.

One new additional load being proposed for the Central Montana Area is a 1,000 HP sapphire mine located near Judith Gap.

2.3.2 Population Growth

Population data from the 1980 census is provided in Table 2.3-1 for the three counties involved in this study.

Table 2.3-1. Population of Counties in the Central Montana Area: 1960, 1970 and 1980.

COUNTY	YEAR 1980	YEAR 1970	YEAR 1960	% CHANGE 1970-1980	% CHANGE 1960-1970
Fergus	13,076	12,611	14,018	3.7	-10.0
Judith Basin	2,646	2,667	3,085	-0.8	-13.5
Wheatland	2,359	2,529	3,026	-6.7	-16.4
Total	18,081	17,807	20,129	1.5	-11.5

Population projections based on a Western Analysis export base model are shown in Table 2.3-2; a full description of the model is contained in Supplemental Report No. 1.

Table 2.3-2. Population Projections for Fergus, Judith Basin and Wheatland Counties, 1982-1990.

COUNTY	1982	1983	1984	1985	1990
	YEAR				
Fergus	13,372	13,509	13,640	13,777	14,522
Judith Basin	2,665	2,669	2,673	2,685	2,716
Wheatland	2,405	2,435	2,465	2,481	2,617
Total	18,442	18,613	18,778	18,943	19,855

2.4 Proposed Solution

In order to correct the existing inadequate voltage levels under single contingency outage and the low voltage problems expected to occur under normal operating conditions as early as 1984, the Applicant proposes to build a 32-mile long, 100-kV transmission line from a new substation west of Judith Gap to the existing Glengarry Substation. This choice was made after consideration and rejection of a number of alternatives discussed in Section 3.

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SECTION 3: ALTERNATIVES TO THE PROPOSED LINE

3.1 Alternatives Considered

A number of alternative actions were considered before the 100-kV line between Judith Gap and Glengarry was selected. Those alternatives can be divided into two classes:

1) Non-transmission alternatives, and
2) Transmission alternatives.

The non-transmission alternatives consist of several forms of on-site generation facilities, conservation, and load control techniques. Briefly, the on-site generation alternatives suffer in comparison to the preferred alternative on the basis of cost. Conservation suffers due to a lack of conservation potential sufficient to reduce existing and potential voltage problems, and load control techniques cannot produce the required reductions. Alternative transmission configurations considered consisted of both alternative electrical configurations and alternative locational configurations. The detailed comparison of alternative locations is deferred until Section 5. The alternative electrical configurations considered generally were less able to solve the existing problem.

3.1.1 Non-Transmission Alternatives

3.1.1.1 On-Site Generation Alternatives (Technological Alternatives)

As noted in Section 2.1, the existing and worsening problem in Central Montana is inadequate voltage levels. To solve this problem, 23 megawatts of additional power (peak) must be supplied to the Lewistown area in 1984. For the longer term, a minimum of 30 megawatts is required. Several available or emerging technologies were looked at as a power source of this magnitude.

3.1.1.1.1 <u>Solar Technologies</u>

A number of solar generating technologies are presently under development including solar thermal conversion and solar photovoltaic generation. A solar thermal conversion plant consists of an array of mirrors concentrating the heat of the sun onto a boiler--steam from this boiler turns a steam turbine. A solar photovoltaic array consists of light sensitive silicon chips that convert the sun's energy directly into electricity; an inverter is required to convert the solar generated direct current electricity into consumer useable alternating current electricity.

Both schemes have massive material requirements; tons of glass, steel, and concrete are required for either type of facility, bringing important environmental considerations into play. Land requirements for such facilities are also great--a solar thermal plant may require six acres per megawatt of capacity, while a comparable photovoltaic array could occupy twice as much land due to the low efficiency of state-of-the-art solar cells. Solar generated electricity costs several times as much as conventional generation and will probably not be competitive in the energy market for another 30 years (National Academy of Sciences, 1980).

Besides a general lack of advanced technology, solar energy cannot be relied on as a "firm" source of energy without expensive storage facilities due to the intermittent nature of sunshine. Worse yet, the availability of solar generated electricity is further limited in the winter months when heating loads are greatest. In addition to reduced hours of sunshine per day, snow and cloud cover decrease the efficiency of the reflecting mirrors or solar cells. In general, Montana would be a poor location for a solar generating facility.

3.1.1.1.2 Wind Turbine Generation

The Applicant has an active interest in wind turbine generation. Winds have been monitored in the Big Timber, Whitehall, and Livingston areas to investigate the potential for wind turbine sites, and a meteorological tower and 25-kW wind generator have been installed in the Livingston area on an experimental, data-gathering basis. Units ranging in size from one-half kilowatt to several megawatts are currently available with a plant cost of about $1,500 per kilowatt of generation capacity.

Although many of the technical problems associated with wind generation have been solved, wind generation at present is more useful to the individual customer as a supplementary power source rather than a reliable, alternate power source to be depended on by a large utility. Wind energy conversion has problems similar to solar energy conversion; wind is intermittent in nature, thus wind generation cannot be relied upon as a firm source. Peak electricity demands and peak winds often would not coincide. If wind generation were to be depended on as a firm source, costly storage facilities are required. Land requirements are also great, as individual machines must be spaced far apart to prevent interference with each other. One study suggests a 1,000 megawatt wind turbine facility could require as much as 200 to 500 square miles of land (National Academy of Sciences, 1980). Associated environmental and social considerations are probably significant.

3.1.1.1.3 Hydroelectric Generation

As stated previously, the Lewistown area requires 30 megawatts of local generation to provide a long-term solution for present and anticipated voltage problems. Unfortunately, the Lewistown area does not have the water

resources available to supply a 30 megawatt hydroelectric facility. Even if water resources were available, such a facility would not be a cost effective solution to the area's voltage problems. Comparably sized hydroelectric facilities are: Hauser (16.5 megawatts), Black Eagle (18 megawatts), Rainbow (35 megawatts), and Thompson Falls (40 megawatts).

3.1.1.1.4 Gas Turbine Generation

Gas turbine generation is becoming more common in areas where additional load support is required. In the Lewistown area, a 30-megawatt gas turbine facility could be constructed in 15 months or less by a 75-man work force (peak). Approximately 20 acres of land are required for such a facility. A natural gas pipeline and liquid fuel (diesel) storage would have to be provided. Carbon dioxide, oxides of nitrogen, and sulphur dioxide are emitted from such plants; a water treatment facility (and water resources) is required for pollution control. A gas turbine facility also requires a one-man operating crew.

3.1.1.1.5 Summary of On-Site Generation Alternatives

Most of the alternative technologies explored are not feasible due to lack of resources and/or limitations of state-of-the-art technology, and could not provide a firm source of power for the Lewistown area. None of the technologies are cost-effective when compared to the transmission line alternative (see Table 3.1-1).

In addition, a generating facility's protective switchgear is more sensitive to system disturbances (voltage fluctuations, faults, etc.) than that of a transmission line; system disturbances could cause local generation to trip off-line when it is needed most (such as during a line outage). A

transmission line is more stable during system disturbances.

Table 3.1-1. Cost Comparison: 30 MW Local Generation Versus New Transmission Line (Installation Costs Only).

ALTERNATIVE	ESTIMATED COST
Solar Thermal Plant	\$300 million[a]
Solar Photovoltaic Array	\$300-900 million[b]
Wind Farm	\$45 million
Hydroelectric Plant	N/A
Gas Turbine Facility	\$12-13 million
Transmission Line (32 miles)	\$1.8 million

[a]Source: Energy in Transition 1985-2010 p. 366.
[b]Source: Energy in Transition 1985-2010 p. 368.

The only feasible, firm alternative solution is a gas turbine facility. When compared to the transmission line alternative, however, a gas turbine facility would take three to four times as long to construct, would cost seven times as much, and would require twice the construction manpower (see Table 3.1-2). A gas turbine requires local water and natural gas to operate, while the transmission line would rely on existing generation. A gas turbine facility has small land requirements, but the land used by this facility could not be used for additional purposes; transmission line right-of-way can still be farmed, used to raise livestock, etc. Finally, as mentioned previously, a gas turbine facility may be unreliable during system disturbance.

In summary, local generation will not provide a reliable, cost-effective, and environmentally favorable solution to the Lewistown area voltage problems.

Table 3.1-2. Gas Turbine Facility Construction and Operation Requirements Versus Transmission Line Requirements.

	TRANSMISSION LINE	GAS TURBINE FACILITY
Construction Duration	4 months	13-15 months
Construction manpower (Peak)	35 men	75 men
Construction Cost	$1.8 million	$12-13 million
Land Required	227 acres[a]	20 acres
Local Resources Required	None	Water, Natural Gas

[a]This is transmission line right-of-way. The land can still be used for other purposes such as farming, livestock, etc.

3.1.1.2 Conservation Alternatives

Another potential alternative to building the proposed transmission line is to nullify the need for the additional power through instituting conservation measures. The following paragraphs describe past and existing conservation programs of the Applicant and evaluate the potential for future conservation to reduce Central Montana loads by 30 megawatts.

3.1.1.2.1 Energy Conservation Program and Effects

Conservation can be defined as improved efficiency of use; improvements in efficiency are generally accomplished in response to escalation of prices. Conservation was not a topic of concern in the pre-1973 era because the price of energy was low. Energy, petroleum specifically, caused anxiety when prices began rising rapidly, squeezing incomes at all levels of society. The eventual reaction to rising oil prices was investment to increase the efficiency of oil utilization. Consumers also moved to change consumption habits. The reaction to rising electricity costs will be similar. Consumers will tend to change their consumption

habits and undertake one of the conservation strategies outlined in Table 3.1-3 in an attempt to improve their utilization efficiency. The forecast effects of these price-induced conservation measures are shown in Table 3.1-4 (note that average megawatts rather than peak megawatts are shown). These estimates incorporate all the cost effective conservation measures which will be undertaken by consumers at the prices forecast to be in effect during each year of the forecast (Montana Power Company, 1982).

The Applicant has been involved in assisting its customers in energy conservation for many years. Starting in the early 1960's, the Applicant developed programs to encourage customers to insulate their homes to higher standards than those generally thought to be necessary at the time. This effort was concentrated in the area of electric space heating. As a result of that effort, most homes built on the Applicant's system from that time have been well insulated and possess most of the conservation strategies not considered standard until relatively recently.

With the start of the Arab oil embargo in 1973, the Applicant's conservation activities accelerated to provide expanded customer information services including bill inserts, brochures, and workshops, etc. In 1978, work began on the implementation of a residential energy audit service for all residential space heating customers. This program, which started in 1979, was implemented long before any mandatory state or federal requirements (which are still not in effect).

This residential energy service (the ESP program) consists of a comprehensive examination of customer homes to determine the best energy conservation strategies (cost-effective and

Table 3.1-3. Potential Conservation Strategies by Consumer Class.

- Residential Strategies
  - . Thermal Integrity
    - Ceilings
    - Walls
    - Floors
    - Infiltration
    - Windows
  - . Solar
    - Space Heat
    - Water Preheat
  - . Appliance Efficiency Improvement
    - Space Heat
    - Water Heat
    - Range
    - Dryers
    - Refrigerators
    - Freezers
    - Clothes Washer
    - Dishwasher
    - Television
    - Air Conditioners
    - Lighting
  - . Geothermal
  - . Photvoltaics
  - . Wind

- Commercial Strategies
  - . Thermal Integrity
    - Ceiling
    - Walls
    - Floors
    - Infiltration
    - Windows
  - . Lighting
  - . HVAC (Heating, Venting, Air Conditioning)
  - . Water Heating

- Industrial Strategies
  - . Cogeneration
  - . Lighting
  - . Heating/Cooling
  - . Motors and Pump
  - . Refrigerators/Freezers

- Irrigation Strategies
  - . Pump Testing and Repair
  - . Low Pressure Center Pivot Irrigation
  - . Irrigation Scheduling
  - . Drip Irrigation
  - . Wind-Pumps

Sources: The Montana Power Company.
Hittman Associate, Inc., July 1981.
BPA, 1981.

Table 3.1-4. Price Induced Conservation, Most Likely Scenario (Average MW).

	1985	1990	1995	2001
Residential Sales[a]				
With Conservation	231	294	357	416
W/O Conservation	243	338	422	513
Difference	12	43	65	97
% Difference	5.2	14.6	18.2	23.3
Commerical Sales[a]				
With Conservation	198	229	255	275
W/O Conservation	204	251	294	335
Difference	5	22	39	60
% Difference	2.5	9.6	15.3	21.8
Industrial Sales[a]				
With Conservation	74	80	86	93
W/O Conservation	88	97	107	118
Difference	14	17	21	25
% Difference	18.9	21.2	24.4	26.9
Contract Sales[b]				
With Conservation	176	189	192	191
W/O Conservation	186	199	203	205
Difference	10	10	11	14
% Difference	5.7	5.3	5.7	7.3
Other Sales[c]				
With Conservation	86	102	119	144
W/O Conservation	92	119	144	182
Difference	6	17	25	38
% Difference	7.0	16.7	21.0	26.4
Total Sales[c]				
With Conservation	765	895	1,009	1,119
W/O Conservation	812	1,004	1,170	1,353
Difference	47	109	161	234
% Difference	6.1	12.2	16.0	20.9

[a] Source: Econometric Model.
[b] Source: Personal Interview and judgement.
[c] Source: Contract interpretation and judgement.

structurally feasible) for achieving the greatest savings. The program was a resounding success with some 5,000 energy audits being performed during the first full year of operation.

In conjunction with the energy audit program, and to further bolster the efforts of energy conservation and to expand its commitment, a "Zero Interest" energy conservation loan program was also instituted by the Applicant. This program permits eligible customers to borrow up to $1,500 to implement cost-effective energy conservation measures and have up to 36 months to repay the loan with no interest charge. This combination of an energy audit service and a zero-interest loan program motivated some 14,000 residential customers to participate in the audit service program to date, with some 4,500 participating in the loan program.

The success of the ESP energy conservation programs has demonstrated the interest of residential customers in installing cost-effective energy conservation. This incentive approach, coupled with rising energy prices, may be one of the best strategies to achieve significant energy conservation in the residential sector.

Expansion of the ESP program began in 1982 and is designed to implement the federally mandated Residential Conservation Service Program. The Applicant worked with the State of Montana in insuring that the citizens of Montana have the best energy conservation programs possible. In addition to the benefits of the Residential Conservation Service Program, Applicant customers have an expanded opportunity to obtain up to $2,000 (at zero-interest with 48 months to repay) to implement cost-effective energy conservation. A domestic solar water heater system is also offered as a part of this expanded loan program.

The customer conservation programs instituted by the Applicant are among the best in the nation. The high customer response, and the savings realized by those who have implemented various conservation strategies, shows the success of this methodology for achieving substantial energy conservation in the residential sector.

Most of this success has been manifested in natural gas savings; it is expected these programs will have little effect on the Applicant's electricity loads due to the low saturation of both space and water heat (approximately 12 percent and 30 percent, respectively) and the relative newness of most electrically heated homes. Insulation levels in most electrically heated homes are already high and the vast majority of electric water heaters are of the new, well insulated type. Also, most water heaters are already located in a heated area of the home as opposed to an unheated garage or crawl space (Montana Power Company, 1982).

3.1.1.2.2 <u>The Potential For Conservation</u>

The Applicant specifically incorporates conservation in its service territory electric load forecasts--via price elasticities for the Residential, Commercial and Industrial sector econometric models, and judgementally for the Contract Industrial and Other sectors. Beyond this, to assure conservation possibilities are not overlooked, the Applicant examines conservation potential by end-use where data are available. These analyses can be overlayed on the Lewistown area by making two assumptions: 1) the Lewistown area will grow within the range predicted for the entire service territory, making it possible to interpolate the results of the service territory forecasting model to the Lewistown area; and 2) that conservation potential is approximately evenly distributed throughout the service territory, making it possible to interpolate the Applicant conservation

potential analyses to the Lewistown area. These two projections provide some insight into the probable future growth in electrical energy consumption in the Lewistown area.

- Econometric Model

The range in average annual growth rates for total sales in the Applicant service territory forecast through 1995 is 2.4 to 3.4 percent. These growth rates do not include the Contract Industrial sector since none of the Applicant's current contract customers are in the Lewistown area, nor do we forecast any to locate there through 1995. Consumption in the Lewistown area in 1980 was 147,947 MWh. By applying the two growth rates stated above through 1995, a consumption forecast range of 211,157 to 244,295 MWh is calculated. Remembering that the growth rates applied here include, via price responses, all cost-effective conservation the Applicant expects over the forecast period, the conclusion can be drawn that conservation, at best, will not reduce electricty consumption in the Lewistown area below current levels. The need for the proposed transmission line cannot be avoided through acquisition of cost-effective conservation in the Lewistown area given the Applicant's forecast of future electric rates.

- Technical Conservation Potential

The technical potential of a conservation strategy is the maximum amount of energy savings which can be achieved if the strategy is implemented without regard to cost effectiveness. The Applicant estimates the technical potential in the service territory for space and water heating strategies in the Residential Sector is 17.2 average MW. A conservation study of the Pacific Northwest by Hittman Associates, Inc. (1981) indicates these strategies comprise approximately

38 percent of the total conservation potential available in the region (including customer-owned generation). Assuming this ratio is approximately representative of the the Applicant service territory, estimated technical conservation potential is 45.0 average MW.

The Lewistown area comprised 2.6 percent of the Applicant's total sales in 1970, and 2.7 percent in 1980. Using 3.0 percent as a forecast of the portion of total system sales Lewistown contributes in 1995, in conjunction with a service territory-wide conservation potential of 45.0 average MW, yields a technical conservation potential of 1.2 average MW or 10,512 MWh. Comparing this to the expected growth, even at the low side of the range, indicates the Lewistown area does not have enough conservation potential, regardless of cost, to alleviate the need for the proposed transmission facility. This is the case even though the technical conservation potential represents an upper boundary estimate of what might reasonably be achieved. There are three reasons the technical potential is probably not achievable: 1) much of it is not cost-effective; 2) not all consumers who could participate in a conservation program will choose to do so, and these estimates are based on 100 percent participation; and 3) some of the savings due to implementing a conservation strategy in a home or business, such as ceiling insulation, may be offset by changes in consumer behavior or practices, such as increasing the thermostat setting.

- <u>Peak Considerations</u>

Conservation programs, particularly related to space and water heating, have little effect in reducing peak loads; they primarily save energy. The reason for this is conservation programs generally do not reduce connected load and it is the potential for the connected load to produce a

peak which the utility plans against. In the case of the Applicant, this planning strategy is logical and prudent. The Applicant system peaks occur near the end of a three or four day cold snap when the most of the diversity has been wrung out of the system. The probability for all connected loads to be operating coincidentally is high. Also, peaks on the Applicant's system last for three to four hours and often occur in both the morning and the evening of the same day further increasing the chance the vast majority of all connected loads will be demanding power concurrently. To the extent the proposed transmission facility is required to serve peak load requirements, the conservation potential in the Lewistown area does little to alleviate the need for the facility.

3.1.1.3 Load Control Techniques

Load control techniques are used to flatten out load fluctuations which are higher than the average load value for a given area. The ideal load management system would keep all load flucuations at or very near the average load value; however, this may create very large, complex and expensive load management systems. The cost of a load management system is inversely related to density of the load for a given area; i.e., the more dense an area is (urban areas) the cheaper the system--the less dense the area (rural areas), the more costly the system. The type of customer will also determine, to a large extent, how much load can be controlled.

The Central Montana Area is very large and sparsely populated; only two or three cities have high load densities. The amount of load to be controlled in the area will be about 23 megawatts by 1984 and up to 30 megawatts in 1990; this represents a substantial portion of the 40 megawatt load expected for the area in 1984 and will severely stress the

load management system (especially during extended outage periods).

From an electrical standpoint, the load management system is not suited for the Central Montana Area problems and will not provide long-term benefits for the area.

3.1.2 Transmission Alternatives

Several transmission alternatives were initially investigated as possible solutions to the Central Montana area voltage problems. After an initial screening, four feasible options were selected and subjected to an overall comparison using economic, engineering and environmental criteria. These four alternatives will be described at the end of this section. Descriptions of some of the rejected alternatives follow.

3.1.2.1 Reconductor Three-Strand No. 8 CU Conductor 50-kV Line

One of the alternatives considered was to reconductor the existing three-strand No. 8 CU conductor 50-kV line from the Harlowton Substation to the Glengarry Substation, and from the Glengarry Substation to the Stanford Substation. However, this would not even provide a short-term solution to the current voltage problems in the Lewistown area, and would not increase the reliability of the transmission system--an outage on the Benchland-to-Glengarry 100-kV line would still cause severe low voltages on the 50-kV system.

3.1.2.2 Reconductor and Convert Existing 50-kV System to 69 kV

Another short-term solution might be to reconductor the existing 50-kV system and convert it to 69 kV. However, the cost of changing the distribution substation transformers,

and the transmission transformers at the Stanford, Benchland and Harlowton substations, plus converting the transmission lines, would be more expensive than any of the four options retained. Additionally, this alternative is only a short-term solution; it does not solve outage problems which may occur on the 100-kV transmission system.

3.1.2.3 New 100-kV Line Between Benchland and Glengarry Substations

Building a new 100-kV transmission line from the Benchland Substation to the Glengarry Substation would solve the outage problem on either of the 100-kV lines, but an outage on the 100-kV line between the Great Falls Substation and the Wayne Pump Substation causes voltage problems on both the 100-kV system and 50-kV system.

Several other 100-kV transmission line options were also examined, but with the same results as described above (low voltages exist for different outages). This implies more than one 100-kV transmission line will be needed to provide adequate, reliable service to the Central Montana Area. By tapping the Broadview-to-Great Falls 230-kV transmission line, considerable support to the 100-kV transmission system is provided; by building a 100-kV line from a 230-kV substation to the Glengarry Substation, the reliability of the 50-kV system is also increased.

3.1.2.4 Feasible Transmission Options

The survey of transmission alternatives culminated in the selection of four feasible options:

OPTION No. 1 - Build a 74-mile long 100-kV transmission line from the Roundup Substation to the Glengarry Substation. This option requires a tie from the existing Great Falls-Broadview 230-kV line to the 100-kV line between Harlowton and Stanford.

OPTION No. 2 - Tap the Broadview-to-Great Falls 230-kV transmission line in the vicinity of the town of Stanford. Build two 100-kV transmission lines (5.5 and 6.5 miles, respectively) to the Stanford Substation. Build a 36-mile long 100-kV transmission line from the Stanford Substation to the Glengarry Substation.

OPTION No. 3 - Tap the Broadview-to-Great Falls 230-kV transmission line in the vicinity of the Benchland Substation. Build two 100-kV transmission lines (7 miles and 7.5 miles, respectively) to the Benchland Substation. Build a 27-mile long 100-kV transmission line from the Benchland Substation to the Glengarry Substation.

OPTION No. 4 - Tap the Broadview-to-Great Falls 230-kV transmission line in the vicinity of the town of Judith Gap. (At this location, the 230-kV transmission line parallels, at 100 feet, the 100-kV transmission line for several miles). Build a 32-mile long transmission line from the Judith Gap Substation to the Glengarry Substation.

After an intensive two-phase evaluation process, Option No. 4 (including a preferred routing for that option) was selected as the best solution to the problem outlined in Section 2.1. The evalution process is described in detail in Section 5.

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SECTION 4:
DESCRIPTION OF THE PROPOSED LINE

4.1 Engineering Design

Determination of many of the engineering features of the proposed line depends upon the final route selected. In Section 5, a two-phased route selection process is described. Phase I produced four routes which were retained for further analysis in Phase II of the selection process. These four routes extend one mile to either side of the reference centerlines shown in Figure 4.1-1. However, preliminary cost estimates and environmental analyses shown in Section 5 clearly demonstrate Route No. 4 (segments FG in Figure 4.1-1) is not a viable alternative and no further engineering investigations were completed on that route. Therefore, the engineering analyses described in the remainder of Section 4 are based on Routes No. 1 (ABDEF), No. 2 (ABCDEF), and No. 3 (ABCEF) only. (Exhibit H, Volume III provides a reference map and detailed descriptions of potential construction constraints for each of the three routes.)

4.1.1 Overview

4.1.1.1 Length, Voltage and Surge Impedance Loading

Route No. 1 is about 32.0 miles in length; Routes No. 2 and No. 3 are approximately 36.5 and 35.5 miles in length, respectively. Operating at 100-kV nominal voltage, the new Judith Gap-to-Glengarry line will have a surge impedance loading of 29.8 megawatts for all three routes.

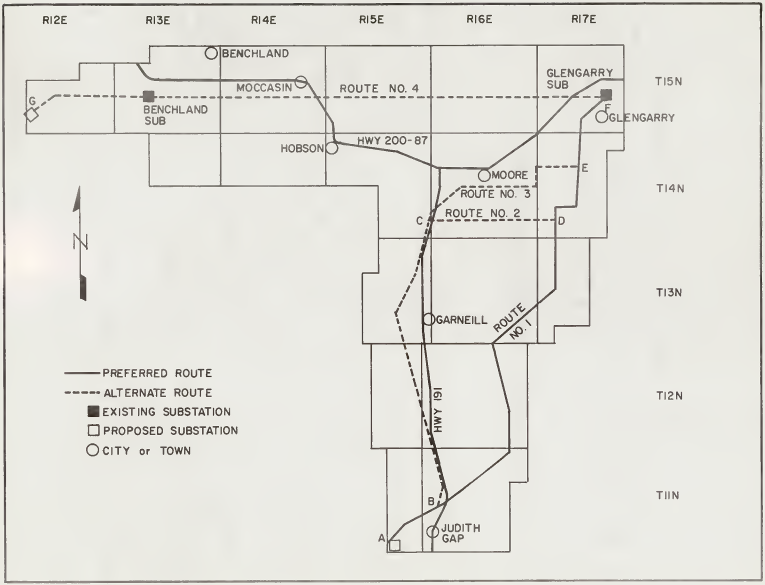


Figure 4.1-1. Phase II Study Area Showing Four Alternative Routes.

4.1.1.2 Substations

Two substations are affected by the proposed transmission line. A new 230/100-kV auto substation will be required at a location approximately two and one-half miles west of Judith Gap at a point on the existing Billings-to-Great Falls 230- and 100-kV lines. One 230/100-kV auto transformer, two 230-kV oil circuit breakers, and four 100-kV oil circuit breakers will be required at this location.

The existing Glengarry Substation will be the other terminal for the proposed line. Two additional 100-kV oil circuit breakers will be required to accommodate the new line; one of the breakers will be installed on the existing Benchland-to-Glengarry 100-kV line and one breaker will be installed on the proposed line.

The locations of the existing Glengarry Substation and the proposed auto substation are shown in Figure 4.1-1.

4.1.1.3 Construction Schedule

Modifications in the Glengarry Substation will take about one and one-half months to complete, with construction beginning in August 1984. Construction at the Judith Gap Auto Substation will take about four months, with construction commmencing in June 1984. Transmission line construction will also begin in June 1984, and will last four to four and one-half months, depending upon the route selected. All construction should be completed by early October 1984. Construction schedules are discussed in Section 4.2.2.

4.1.2 General Design

4.1.2.1 Corona Loss

Corona is a function of voltage level, elevation, weather, conductor size, and other factors normally present. Due to these factors, transmission lines normally operate at voltage gradients of 65 to 85 percent of the critical voltage gradient (21.1kV/cm). The theoretical voltage gradient of the proposed 100-kV line will be 10.9kV/cm or 51.5 percent of critical based on a horizontal conductor configuration for all options. The corresponding corona loss will be 0.16 kW/mile/conductor, or 0.05 kW/mile total for all options (based on an estimated 4,500 foot elevation, a maximum conductor operating temperature of 167°F, and a horizontal conductor spacing of 10.5 feet).

4.1.2.2 Right-of-Way

The Applicant's standard right-of-way width for 100-kV transmission is 60 feet; in some places, such as in cultivated areas, this width may be reduced to 40 feet.

4.1.2.3 Line Losses and Transfer Capacities

Line losses and transfer capacities were calculated for each of the three Judith Gap-to-Glengarry routes (Routes No. 1, No. 2 and No. 3). The results, shown in Table 4.1-1, are based upon a 10 percent voltage drop with a load power factor of 0.95. Line losses were calculated as a percent of the conductor thermal rating (92 mva at 100-kV nominal voltage).

Table 4.1-1. Line Losses and Transfer Capacities by Route.

ROUTE	SOURCE VOLTAGE (PER UNIT)	LOAD VOLTAGE (PER UNIT)	VOLTAGE DROP %	LOAD POWER FACTOR	TRANSFER CAPACITY (MW)	LINE LOSSES AS % OF THERMAL RATING
1 (ABDEF)	1.0	0.9	10.0	0.95	50.0	3.5
2 (ABCDEF)	1.0	0.9	10.0	0.95	43.0	3.0
3 (ABCEF)	1.0	0.9	10.0	0.95	44.0	3.1

4.1.3 Specific Design

4.1.3.1 Conductors per Phase

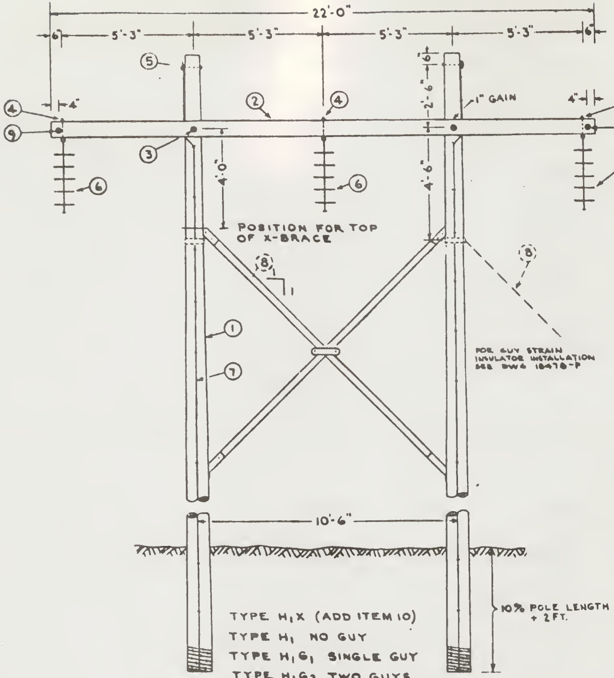
One conductor per phase will be used for the proposed transmission line.

4.1.3.2 Conductor Configuration

Bundled conductors will not be used on the proposed transmission line. Generally, the conductors will be spaced 10.5 feet apart in a flat (horizontal) configuration (see Figure 4.1-2). The alternate conductor configuration will be triangular (see Figure 4.1-3); the sides of the triangle measure 7.0, 11.0, and 11.5 feet (some short line segments may require the alternate structure type). To comply with the National Electric Safety Code, the conductor ground clearance will be no less than 27.5 feet at a conductor temperature of 60°F.

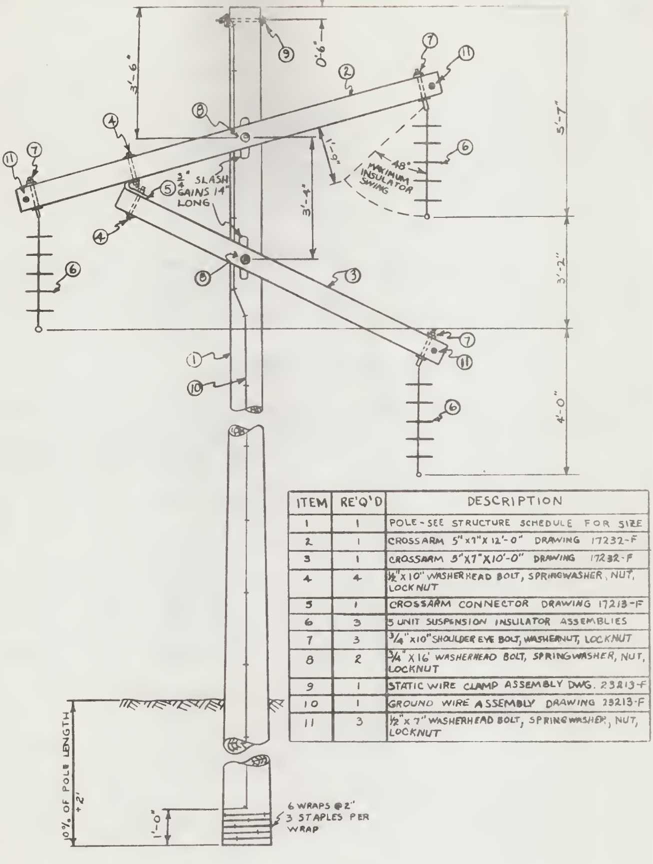
4.1.3.3 Conductor Description

The current-carrying conductor for the proposed line will be 336,400 circular mill aluminum cable steel reinforced (ACSR). The conductor, code name "Linnet", consists of 26 aluminum



ITEM	REQ.	DESCRIPTION
1	2	POLE, SEE STRUCTURE SCHEDULE FOR SIZE
2	1	X-ARM, 5"x7"x22'-0" DWG. NO. 17233-F
3	2	3/4"x14" OR 16" WASHERHEAD BOLT, SPRING
		WASHER, NUT & LOCKNUT.
4	3	3/4"x10" SHOULDER EYE BOLT, WASHERNUT &
		M. F. LOCKNUT.
5	2	STATIC WIRE CLAMP ASSEMBLY DWG. 23213-F
6	3	5-UNIT SUSPENSION INSULATOR ASSEMBLIES
7	2	GND. WIRE ASSEMBLIES DWG. 23123-F
8	0 TO 2	GUY ASSEMBLY DWG. 9364-F
9	2	1/2"x7" WASHERHEAD BOLT, SPRING WASHER,
		NUT & LOCKNUT.
10	0 OR 1	X-BRACE ASSEMBLY DWG. 17244-F

Figure 4.1-2. Flat (Horizontal) Conductor Configuration, H_1X Structures.



ITEM	RE'Q'D	DESCRIPTION
1	1	POLE - SEE STRUCTURE SCHEDULE FOR SIZE
2	1	CROSSARM 5"x7"x 12'-0" DRAWING 17232-F
3	1	CROSSARM 5"X7"X10'-0" DRAWING 17232-F
4	4	½"X 10" WASHERHEAD BOLT, SPRINGWASHER, NUT, LOCKNUT
5	1	CROSSARM CONNECTOR DRAWING 17213-F
6	3	5 UNIT SUSPENSION INSULATOR ASSEMBLIES
7	3	¾"x10" SHOULDER EYE BOLT, WASHERNUT, LOCKNUT
8	2	¾" X 16' WASHERHEAD BOLT, SPRINGWASHER, NUT, LOCKNUT
9	1	STATIC WIRE CLAMP ASSEMBLY DWG. 23213-F
10	1	GROUND WIRE ASSEMBLY DRAWING 23213-F
11	3	½"x 7" WASHERHEAD BOLT, SPRINGWASHER, NUT, LOCKNUT

Figure 4.1-3. Alternate (Triangular) Conductor Configuration, S_1W Structures.

strands wrapped around a seven-strand steel core. Depending on structure type, the conductors will be protected from lightning by one or two over-head static ground wires. Three-eighths inch high-strength steel strand (seven strands) will be used for these static wires.

4.1.3.4 Voltage Gradient

As previously mentioned, the theoretical voltage gradient of the proposed 100-kV line will be 10.9kV/cm (51.5 percent of critical) based on the hoizontal conductor configuration.

4.1.3.5 Equivalent Phase Spacing

The equivalent phase spacing of the horizontal conductor arrangement is 13.2 feet; the alternate conductor arrangement (triangular) will have an equivalent phase spacing of 9.67 feet.

4.1.3.6 Structure Height

The nominal pole height for the line will be 60 feet, but heights may range from 50 to 80 feet depending upon terrain. The pole height includes that portion of the pole buried in the ground, which is equal to 10 percent of the pole height plus two feet.

4.1.3.7 Structures per Mile

Two-pole wooden "H-Frame" structures, the Applicant's 100-kV type "H_1X" (see Figure 4.1-2), will be the most commonly used structure on the proposed transmission line. These structures will be placed approximately 800 feet apart (6.6 per mile). Some short line sections may require use of

the alternate structure type, the Applicant's 100-kV type "S_1W" single wood pole structures (Figure 4.1-3). The "S_1W" structures will be placed approximately 450 feet apart (11.7 per mile).

4.1.3.8 Substation Land Requirements

The existing Glengarry Substation will not require additional land; equipment needed to accommodate the new line will be placed within the existing substation boundaries. Approximately four acres of land will be required for construction of the Judith Gap Auto Substation.

4.2. Construction Analysis

4.2.1 Construction Labor Force

Crew size will range from a minimum of three to a maximum of about 35 men during construction of the transmission line, with an average employment of 20 men over the life of the contract.

Substation construction will require three to 10 men per substation; average employment will be about four men per substation over the construction phase. Actual crew compliment will depend upon the contractor and manpower availability. Peak employment will occur midway through the construction process. Skill categories include equipment operators, linemen, groundmen, and supervisors.

4.2.2 Construction Component Scheduling

Estimated construction schedules for each route and substation are displayed on the following Gantt and critical path charts (Figures 4.2-1 through 4.2-5).

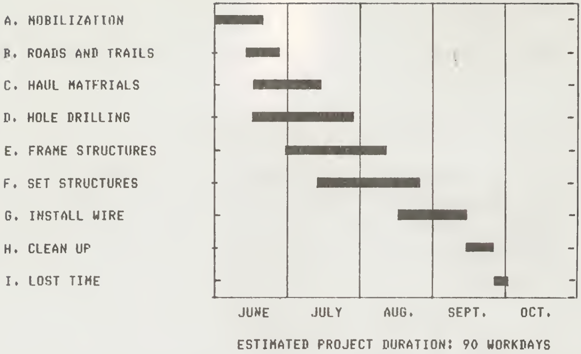
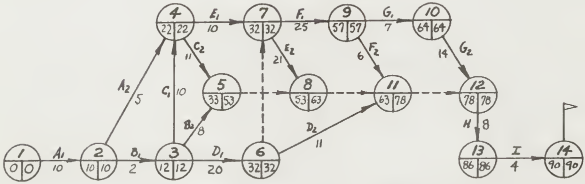


Figure 4.2-1A. Construction Schedule (Gantt Chart) for Route No. 1 (ABDEF).

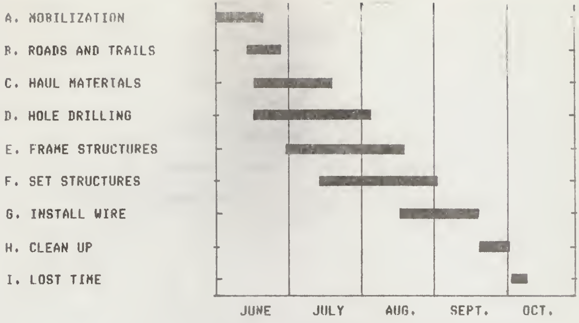


CRITICAL PATHS:
1-2-3-4-7-9-10-12-13-14
1-2-3-6-7-9-10-12-13-14

(90 Days)

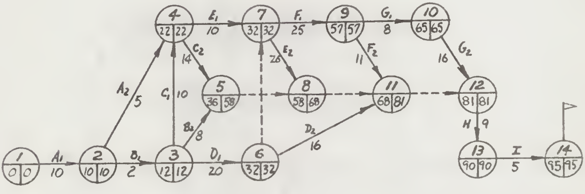
NOTES
1. LETTERS A,B,C,..ETC. REFER BACK TO GANTT CHART ACTIVITIES.
2. SUBSCRIPT "1" REFERS TO PRELIMINARY PHASE OF ACTIVITY.
3. SUBSCRIPT "2" REFERS TO FINAL PHASE OF ACTIVITY.

Figure 4.2-1B. Construction Schedule (Critical Path) for Route No. 1 (ABDEF).



ESTIMATED PROJECT DURATION: 95 WORKDAYS

Figure 4.2-2A. Construction Schedule (Gantt Chart) for Route No. 2 (ABCDEF).



CRITICAL PATHS:
1-2-3-4-7-9-10-12-13-14
1-2-3-6-7-9-10-12-13-14

(95 Days)

NOTES
1. LETTERS A,B,C...ETC. REFER BACK TO GANTT CHART ACTIVITIES.
2. SUBSCRIPT '1' REFERS TO PRELIMINARY PHASE OF ACTIVITY.
3. SUBSCRIPT '2' REFERS TO FINAL PHASE OF ACTIVITY.

Figure 4.2-2B. Construction Schedule (Critical Path) for Route No. 2 (ABCDEF).

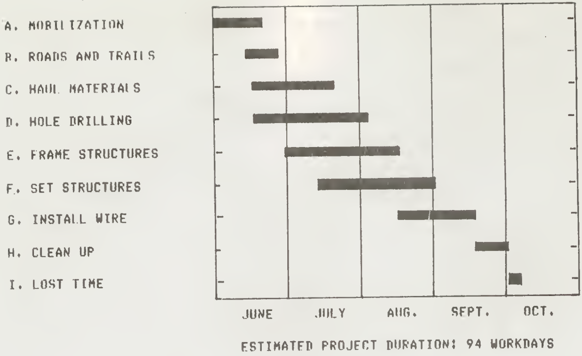
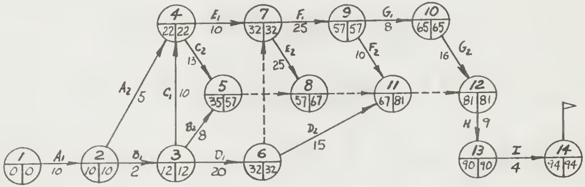


Figure 4.2-3A. Construction Schedule (Gantt Chart) for Route No. 3 (ABCEF).



CRITICAL PATHS:
1-2-3-4-7-9-10-12-13-14
1-2-3-6-7-9-10-12-13-14

(94 Days)

NOTES
1. LETTERS A,B,C...ETC. REFER BACK TO GANTT CHART ACTIVITIES.
2. SUBSCRIPT '1' REFERS TO PRELIMINARY PHASE OF ACTIVITY.
3. SUBSCRIPT '2' REFERS TO FINAL PHASE OF ACTIVITY.

Figure 4.2-3B. Construction Schedule (Critical Path) for Route No. 3 (ABCEF).

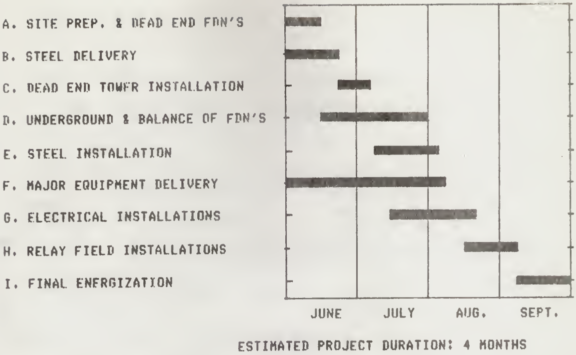
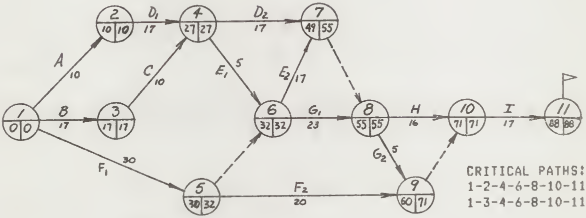


Figure 4.2-4A. Construction Schedule (Gantt Chart) for the Judith Gap Substation.



NOTES

1. LETTERS A,B,C...ETC. REFER BACK TO GANTT CHART ACTIVITIES.
2. SUBSCRIPT '1' REFERS TO PRELIMINARY PHASE OF ACTIVITY.
3. SUBSCRIPT '2' REFERS TO FINAL PHASE OF ACTIVITY.

Figure 4.2-4B. Construction Schedule (Critical Path) for the Judith Gap Substation

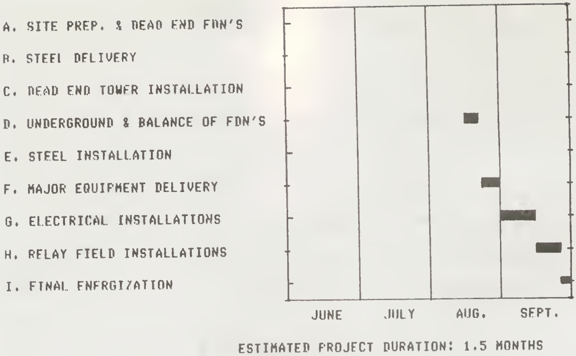
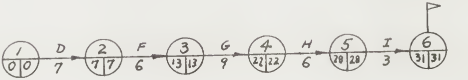


Figure 4.2-5A. Construction Schedule (Gantt Chart) for the Glengarry Substation.



CRITICAL PATH:
1-2-3-4-5-6

(31 Days)

NOTES
1. LETTERS A,B,C...ETC. REFER BACK TO GANTT CHART ACTIVITIES.
2. SUBSCRIPT '1' REFERS TO PRELIMINARY PHASE OF ACTIVITY.
3. SUBSCRIPT '2' REFERS TO FINAL PHASE OF ACTIVITY.

Figure 4.2-5B. Construction Schedule (Critical Path) for the Glengarry Substation.

4.2.3 Construction Methods

Construction methods employed by the Applicant are described in Exhibit I, Volume III, Specifications for Construction of Electric Transmission Lines.

4.2.4 Reclamation Methods

Reclamation methods employed by the Applicant are described in Exhibit J, Volume III, Construction Guidelines for Wood Structure Transmission Lines.

4.3 Research Efforts to Pre-empt Additional Impacts

The Applicant strives to find better ways to provide safe, reliable, and efficient electric power at the lowest possible cost. Structure types, substation equipment, hardware, and construction practices are continuously reviewed and upgraded. The incorporation of new technology is discussed and implemented whenever environmental, social, economic or operational impacts can be further minimized.

As a member of the Edison Electric Institute (EEI) and the Electric Power Research Institute (EPRI), the Applicant contributes to and draws from the pool of research and development resources provided by utility companies throughout the United States. Information on technological advances is also obtained through joint ventures with other utility companies and the diverse trade journals to which the Applicant subscribes.

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SECTION 5: ROUTE SELECTION AND ENVIRONMENTAL IMPACTS

The Preferred Route and Its Impacts

Route Selection: Objectives and Methodology

Phase I: Selection of Candidate Corridors
Definition of Exclusion and Avoidance Criteria
Exclusion and Avoidance Areas Identified
Comparison of Corridor Alternatives
Installation Cost Impacts
Transmission System Operating Performance Impacts
Environmental Impacts
The Selected Candidate Corridors
General Comparison of Candidate Corridors

Phase II: Selection of the Preferred Route
The Alternate Routes Selected
Brief Description of Alternate Routes
Exclusion and Avoidance Criteria
Exclusion and Avoidance Areas Identified
Comparison of Alternate Routes
Installation Cost Comparison
Operating Characteristics Comparison
Environmental Impacts
Route Comparisons

Choice of the Overall Preferred Route

NOTICE TO READER
LIMITATIONS ON CULTURAL RESOURCE ANALYSES

Due to changes in reference centerlines, 13 square miles were added to the original Phase II Study Area. For all resources except Cultural Resources, the required additional information is contained in this application. The additional Cultural Resources data collection and analysis will not be completed until late spring 1983. Thus, the Cultural Resources data presented, and the conclusions derived from them (Section 5.4), are imprecise. There is no reason to suspect the additional data will force major changes in the Phase II conclusions, but such changes are possible. Data and conclusions of the Phase I analysis are in no way affected by the route change.

These conclusions are based on complete data for two-mile wide routes containing the final reference centerlines. (However, the new reference centerlines are no longer consistently in the center of these routes). The Cultural Resources section of this report describes the analytic approach taken, the methods used, and provides a context within which the reader can quickly incorporate the revised data.

5.1 The Preferred Route and Its Impacts

The route preferred by the Applicant (ABDEF) is shown in Figure 5.1-1. This selection was made after a two-phase process which is detailed in the following sections. Before describing the route selection process, expected impacts of building the line in the preferred route are briefly summarized. The following statements refer only to the preferred route.

Construction cost estimates for this project total $6,088,500 (1984 $s) with $4,222,900 representing substation additions and $1,865,600 allocated to transmission line costs. The length of the line will be approximately 32 miles and will add $578,880 in taxable value to tax jurisdictions of Fergus and Wheatland counties. Construction crews are expected to have undiscernible impacts on local public services and facilities and small impacts on private commercial services in the area. Likewise, the expected beneficial impact on the employment of local labor is slight.

Expected impacts of the preferred route on natural resources are minimal. The route crosses 6.5 miles of low impact area based on geologic and hydrologic avoidance criteria, 22 miles of low impact soil types, one stream with low impact potential for water quality and aquatic biota, and 15 miles of wildlife habitat with low impact potential.

Impacts of the line on existing land use will be relatively minor. The reference centerline crosses approximately 18 miles of rangeland and 14 miles of dry cropland; it does not cross mechanically irrigated land. The visual impact of the line should be relatively minor with the majority of the line being a substantial distance from transportation corridors and residences.

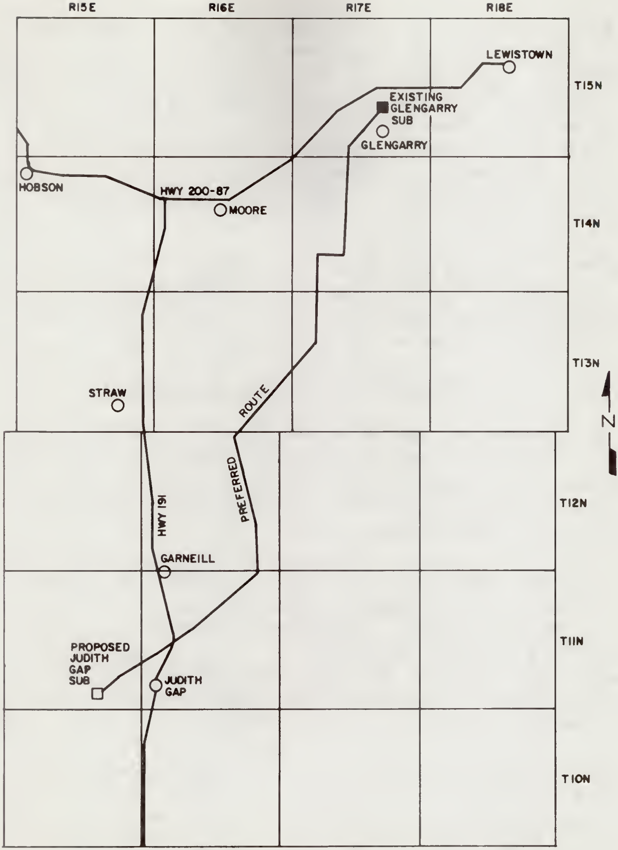

Figure 5.1-1. The Preferred Route.

Potential cultural resource impacts emerge from the existence of eight sites [see Page 53 for limitations] within the preferred route which may be eligible for the National Register of Historic Places; six of these have the potential for moderate impact. Because part of their significance depends upon site setting, they may be indirectly impacted by visual intrusion of the transmission line. However, there is excellent opportunity for impact avoidance or mitigation during centerline selection.

Communications analysis shows the preferred route to have little impact on area communications reception; two houses may experience problems with AM radio reception, one with television reception, and one with FM radio reception.

5.2 Route Selection: Objectives and Methodology

The objective of the selection process is to pick an electrical option and a route for that option which represents the best tradeoff between environmental impact, overall system operating characteristics, and line construction and maintenance costs.

A two-phase selection process was used. The first phase considered a broad study area (Figure 5.2-1) which included all reasonable corridors associated with the four feasible options described in Section 3.1.2.4. Phase II consisted of an intensive analysis of candidate corridors to identify a preferred route. The Phase II study area is also shown in Figure 5.2-1.

Phase I analysis compared costs, operating characteristics and broad environmental impacts associated with each of the options (corridors). The assessment of environmental impacts started with the establishment of broad impact criteria (what environmental features are most likely to be impacted?),

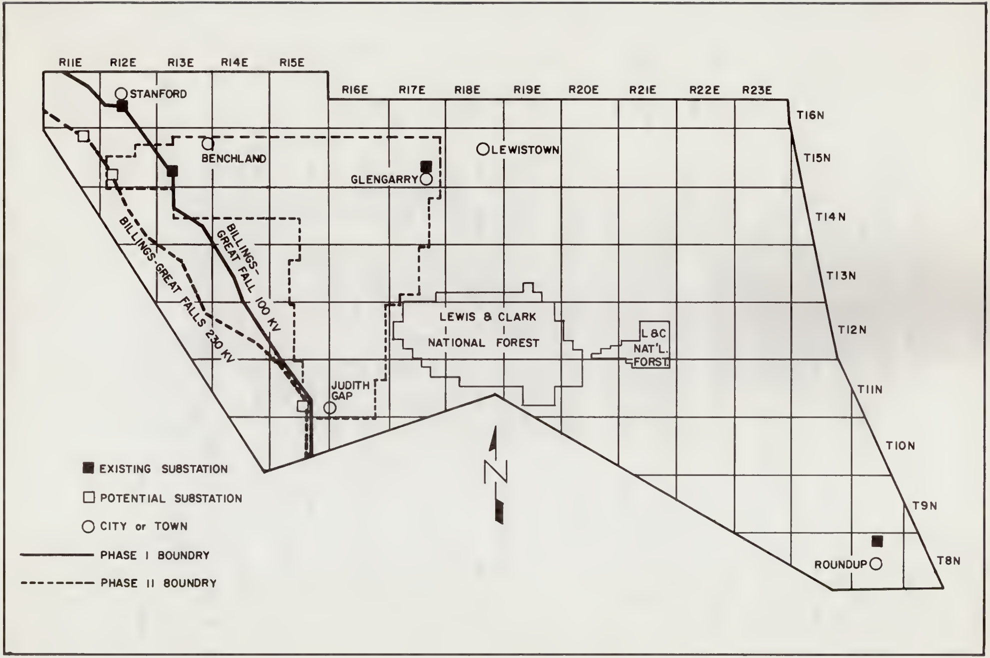

Figure 5.2-1. Phase I and II Study Areas, Central Montana.

followed by a reconnaissance-level resource inventory (where are those features most likely to be impacted located in the study area?). A comparison of likely environmental impacts was then made for each corridor. Cost, system operating characteristics, and environmental impacts were compared and the least desirable corridors were discarded, leaving one or more "candidate" corridors for further analysis.

Phase II subjected the candidate corridors to more intensive analysis which allowed comparison of alternative routes within the candidate corridors, and resulted in the choice of a preferred route for construction of the proposed transmission line.

5.3 Phase I: Selection of Candidate Corridors

The first step in selecting a preferred route was to reduce the size of the study area under consideration by first determining a number of exclusion and avoidance criteria, and then inventorying the study area for features satisfying those criteria. The reconnaissance-level study area is the larger of the two areas shown in Figure 5.2-1. The area includes the three potential new auto substations on the Billings-to-Great Falls 230-kV line (five miles southwest of Stanford, seven miles west of Benchland, and two miles west of Judith Gap), and the existing Glengarry and Roundup substations, together with the area between these five points. The reconnaissance-level inventory revealed areas incompatible with the construction and operation of the proposed transmission line. These results were then combined with construction cost estimates and system operating characteristics to determine which options (study corridors) should be dropped from further study.

The alternative corridors were not given clear boundaries at this level of analysis; reconnaissance inventory work was performed for the overall study area.

5.3.1 Definition of Exclusion and Avoidance Criteria

Exclusion and avoidance criteria were based upon the expected degree of incompatibility (impact) between an existing feature and the proposed transmission line. Exclusion criteria are satisfied if: 1) overhead transmission lines are legally prohibited; 2) impacts to the environment are severe and unmitigable; or 3) the environment would severely impact the construction, operation or maintenance of the proposed line.

Avoidance criteria apply if siting is legal but the environment would suffer impacts or, conversely, if the environment would impact the construction, operation, or maintenance of the line. Within the natural resource areas avoidance criteria were further broken down by intensity of impact into moderate and low categories.

Cost and operating characteristic criteria are not defined explicitly; generally, the line with the lowest costs and line losses and the smallest voltage drop is preferred.

5.3.1.1 Natural Resources

The Phase I natural resource analyses are based on the MultiTech Phase I report which is incorporated by reference and submitted as Supplemental Report No. 2. The following subsections summarize the conclusions of that report.

5.3.1.1.1 Climate

No climatological exclusion or avoidance criteria are pertinent for the study area; potential significant impacts can be circumvented using conventional engineering practices.

The Big Snowy Mountains are located in the center of the study area, with the highest elevation approaching 9,000 feet (2,744 meters); most of the surrounding lowlands are between 3,000 and 4,500 feet (915 and 1,372 meters). In general, the weather patterns affecting the study area are uniform with local climatic changes resulting from exposure and elevation variations.

5.3.1.1.2 Air Quality

Transmission lines of this type and size are not expected to affect air quality, with the possible exception of insignificant amounts of fugitive dust caused during construction.

5.3.1.1.3 Geology

No geologic exclusion criteria pertain to the study area; the only avoidance category area is shown in Table 5.3-1.

5.3.1.1.4 Soils

The influence of soils on the proposed line was evaluated using the landtype suitability analysis system developed by the USDA (USDA, Forest Service, 1976a). This method enables the assessment of the suitability of transmission line siting in a particular area as defined by climate, geologic parent material, and topographic, geomorphologic, edaphic (soil), and vegetative characteristics (USDA, Forest Service, 1976b).

Table 5.3-1. Geologic Exclusion and Avoidance Criteria: Phase I.

I. Exclusion Areas:

None

II. Avoidance Areas:

A. Moderate Impact Areas:

None

B. Low Impact Areas:

1) Areas of Planned, Possible, or Existing Geologic Resource Development(s). The cost of relocating portions of a transmission line to mine or extract the underlying resource(s) may be offset by profits, but where small or marginal zones occur, this cost could cause the extraction of the resource(s) to become uneconomial (Montana Department of Natural Resources, 1974). Areas of high concentrations of abondoned coal workings could present potential problems during and after construction. Such areas have a higher incidence of slumping and landslides due to water movement in the old workings.

The mapping units designated as moderate or low impact are shown in Table 5.3-2.

5.3.1.1.5 Hydrology

No hydrologic features within the study area satisfy the exclusion criteria; however, several features warrant avoidance. Avoidance criteria are listed in Table 5.3-3.

5.3.1.1.6 Water Quality

Water quality-related concerns are not sufficient to warrant any area eligible for exclusion status. Table 5.3-4 summarizes the avoidance area criteria.

5.3.1.1.7 Aquatic Biota

To date, the U.S. Fish and Wildlife Service (USFWS) has not identified aquatic plant or animal species in Montana as endangered or threatened (USDI, FWS, 1980a). It was concluded potential transmission line effects on aquatic biota/habitat are best evaluated by correlating surface water quality conditions to the existing fisheries resource. Fish species generally occupy the uppermost position of the aquatic food chain. Subsequently, the fisheries present serves as a useful indicator of aquatic habitat quality. The importance is reflected in the selection of impact assessment criteria shown in Table 5.3-5.

Table 5.3-2. Soils Exclusion and Avoidance Criteria: Phase I.

I. Exclusion Areas:

None.

II. Avoidance Areas:

A. Moderate Impact Areas:

1. All alpine ridges (i.e., USDA Forest Service mapping unit M10; 1976a). See supplemental Report No. 2, Table 2.2.2-3 for rationale.

2. Shale badlands (i.e., USDA Forest Service mapping unit P3; 1976a). See Supplemental Report No. 2, Table 2.2.2-3 for rationale.

B. Low Impact Areas:

1. All major alluvial floodplains (i.e., USDA Forest Service mapping unit A2; 1976a) due to their flooding potential and probable high water tables.

2. Any USDA Forest Service (1976a) landtype unit that possesses a moderate potential for accelerated erosion (following from soil compaction) and a moderate potential for subsequent elevation of sediment levels in surface (receiving) waters (Hogback ridges, F5; folded sedimentary foothills, F7; slumpy mountains, M6; dissected shale and sandstone plains in conjunction with 10-14 inches of rainfall, P2; dissected shale and sandstone plains with 14-20 inches of rainfall, P6; moderately dissected benchlands, P7).

3. Any USDA Forest Service (1976a,b) landtype unit notably susceptible to geologic or mantle failure-related mass wasting process(es) (slumpy mountains, M6).

Table 5.3-3. Hydrologic Exclusion and Avoidance Criteria: Phase I.

I. Exclusion Areas:

None

II. Avoidance Areas:

A. Moderate Impact Areas

1) Bodies of Standing or Running Water(s) Too Large to Span. Bodies of water greater than 1,000 feet cannot be spanned using conventional design or construction practices used for 100-kV transmission lines.

2) Known Saline Seep Areas Greater Than 40 Acres in Size. Saline seep areas exhibit characteristics similar to that of a marsh. The occurrence of a high water table can contribute to poor structural foundations and the miring of vehicles. Seeps of this size are also too wide to span using conventional 100-kV design or construction practices.

B. Low Impact Areas

1) Areas Within The 100-Year Floodplain. The federal government has adopted the area covered by the 100-year flood as a limit within which restrictions on housing, commercial structures, and other activities are placed for insurance purposes. The location of transmission line towers on floodplains could cause pileups of ice and debris during high spring runoff, possibly contributing to flooding and influencing stream channel changes and bank erosion (Montana Department of Natural Resources, 1974). System reliability and maintenance could be jeopardized by pole placement in areas of poor structure suitability due to the occurrence of high water tables (USDA Forest Service, 1976a).

2) Areas Prone To Saline Seep Developments. Saline seep development is usually associated with the occurrence of Colorado Shale which, when wet, becomes plastic and sticky. This makes vehicular traffic difficult and allows the formation of deep ruts (Department of Natural Resources and Conservation, 1974). Further, Colorado Shale formations have a tendancy to "perc" water (Custer, 1982). The resulting ruts act as ditches which may alter drainage patterns, cause erosion, and increase sedimentation. If seep formation occurred, then the problems described in A2 might develop.

3) Wetlands and Ponds. Land surrounding these areas have a probability of high water tables. These areas may not not be able to support heavy machinery during construction or maintenance without deep rutting of the land surface or miring of vehicles. These ruts can contribute to increased soil erosion and sedimentation of associated drainages.

Table 5.3-4. Water Quality Exclusion and Avoidance Criteria: Phase I.

I. Exclusion Areas:

None.

II. Avoidance Areas:

A. Moderate Impact Areas

None.

B. Low Impact Areas

1) Surface Waters Wherein Regulated Pollutant Levels are Being Approached Are At or Exceed the Legal Water Quality Standard(s). All activities are prohibited where these activities, alone or in combination with other wastes or activities, will cause an exceedance of any standards. If a proposed activity is to be undertaken in an area where there might be an exceedance of standards, a 16.20.633(3) application form must be filed with and authorization received from the Department of Health and Environmental Sciences Water Quality Bureau, prior to the start of construction. If possible, it would be preferable to avoid areas where extra permitting would be necessary.

Table 5.3-5. Aquatic Biology-Related Exclusion and Avoidance Criteria: Phase I.

I. Exclusion Areas:

None.

II. Avoidance Areas:

A. Moderate Impact Areas

1) Specific Locations of Aquatic Vertebrate Species of Special Concern (Flath, 1981) Classifed as Known and Sensitive or Endangered or Threatened. Transmission line construction activities, such as road building, materials staging, and pole placement, have the potential to: 1) accelerate the existing rate of erosion, thus increasing the sediment burden in basin surface waters; 2) alter streamflow; 3) increase organic debris; and 4) increase water temperatures (DNRC, 1976b). These habitat alterations could, depending on timing and duration, affect aquatic insects, fisheries resources, and other aquatic community species (DNRC, 1976b). The direct effects of these habitat changes on those species of special interest or concern which are known to occur in the study area and are sensitive (as defined by Flath, 1981) to habitat disruption, are not known. However, because the state has recognized these species as being of special interest or concern and has classified them as potentially sensitive to habitat disruption, their specific known locations were identified for moderate impact status. The species classified by Flath (1981) are of known occurrence and sensitive to habitat disruption or are threatened or endangered are listed in Table 2.2.3-3 of the Supplemental Report No. 2.

2) Highest Value Fishery Resource. This classification given to streams by the USFWS is based on four criteria: 1) occurrence of state of federal endangered species; 2) occurrence of state or federal threatened species; 3) occurrence of species of high interest to the state; and 4) habitat restoration, reclamation, or mitigation potential. The classification of "Highest Value Fishery Resource" referres to those aquatic systems that: 1) are inhabited by threatened or endangered species, or 2) maintain outstanding populations of species of high interest (due to their aesthetic, scientific, economic, educational, or recreational value), or 3) have a very low potential for restoration or reclamation of the habitat (USFWS, 1980b). The impact to fisheries resources from transmission line siting potentially occurs via the same set of circumstances as described for species of special interest or concern. Because the USFWS has identified "Highest Value Fishery Resource" as critically important, these areas were selected for moderate impact status. Included in this moderate impact category for

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Table 5.3-5. Aquatic Biology-Related Exclusion and Avoidance Criteria: Phase I (Concluded).

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this study are stream stretches within one mile upstream of such a resource to avoid downstream effects.

B. Low Impact Areas

1) Specific Locations of Aquatic Vertebrate Species of Special Concern (Flath, 1981) Classified as Known. The rationale for inclusion of this category as a low impact area is the same as for A1. The only difference between A1 and B1 is that in A1 the conditions of "known and sensitive or threatened or endangered" must be met. In B1 the only condition to be met is that the aquatic vertebrate species of special interest (Flath, 1981) be known to occur within the study area. In addition to these species listed in Table 2.2.3-3 of Supplemental Report No. 2, two other species of special interest or concern are known to occur in the study area; these are listed in Table 2.2.3-4 of the same report.

2) High Priority Fishery Resource. This stream classification assigned by the USFWS was based on the criteria used to identify "Highest Value Fishery Resource" (USFWS, 1980a). Transmission line siting impacts to this resource would occur via the same set of circumstances as described for A1. However, as described by the USFWS (1980b), even though these waters are highly valued for their species composition and have a low potential for restoration, "partial compensation options can be defined." For these reasons those streams classified by the USFWS (1980b) as "High Priority Fishery Resource" are designated as low impact areas. Also included in this category for this study are stream stretches one-half mile upstream of such a resource to avoid downstream siltation effects.

3) Stream With Pre-existing Dewatering or Streambank Erosion Problems. Transmission line impact to aquatic system can occur via the pathways discussed in B1. Streams identified by Kaiser and Botz (1975) as being susceptible to problems from streambank erosion or stream channel dewatering were selected as low impact areas so that pre-existing problems would not be exacerbated by transmission line siting.

5.3.1.1.8 Land Cover

Land cover was defined on the basis of the dominant characteristics of each area (e.g., plant communities and natural features). This approach allowed a siting evaluation in which all land cover was mapped, and suitability comparisons were possible for the entire area. Land cover mapping units were evaluated in terms of suitability for siting a 100-kV transmission line. Siting suitability for land cover classes is presented in Table 5.3-6.

Table 5.3-6. Land Cover Exclusion and Avoidance Criteria: Phase I.

I. Exclusion Areas:

None.

II. Avoidance Areas:

A. Moderate Impact Areas

1) Scree and Alpine Turf. Scree and alpine areas exhibit very slow recovery rates from disturbances due to severe climatic condition and a short growing season. These areas have been recommended for avoidance in previous transmission line siting studies (DNRC, 1976b).

2) Lakes and Reservoirs Greater than 40 Acres or Greater Than 1,000 Foot Span. These land cover types should be avoided due to their unsuitability for tower location.

B. Low Impact Areas

1) Dense, Mature Forest Stands. Right-of-Way (ROW) clearing through dense, mature forest stands may impact the forest ecosystem by converting the stand to an early successional stage.

5.3.1.1.9 <u>Wildlife</u>

Wildlife exclusion and avoidance criteria were developed around cultural (e.g., national wildlife refuges) and biological constraints. Justification for the cultural constraints is that public lands are managed for the public as wildlife habitat or wildlife use areas, and transmission line siting is often viewed as incompatible. Justification for the biological contraints is that some existing wildlife resources may be sensitive to changes in the environment brought about by transmission line siting. Table 5.3-7 lists wildlife exclusion and avoidance criteria.

5.3.1.2 <u>Socioeconomic Resources</u>

For this study, socioeconomic resources include all resources utilized by man with the specific exception of archeologic, historic, and paleontological resources which are discussed separately in Section 5.3.1.3. Overlap exists between natural and socioeconomic resources; e.g., a fishery may be discussed as both a biological population (natural resource) and a recreational asset (socioeconomic resource); the only difference is in the point of view with the focus of the socioeconomic assessment being on man's use of the resource.

Socioeconomic exclusion and avoidance criteria used for Phase I are from the Phase I socioeconomic study conducted by Western Analysis, Inc. This study was based heavily on interviews with area residents and informal interviews with representatives of public resource management agencies. Results of the survey of area residents show that the major concern of the residents is with potential impediments to agricultural activities. Visual concerns were much less prevalent and seemed to stem entirely from the potential impact to property values and views from home residences.

Table 5.3-7. Wildlife Exclusion and Avoidance Criteria: Phase I.

I. Exclusion Areas:

1) USFWS Wildlife Refuges. Transmission line siting on USFWS Wildlife Refuges is not expressly forbidden by law. However, it is USFWS policy not to grant easements across wildlife refuges unless that use is compatible with the purposes for which the lands were acquired (Wood, 1981). In addition, the Secretary of the Interior must approve the easement (16 U.S.C. 668dd). Compatible is defined as "the condition where the requested right-of-way or use will not interfere with or detract from the purpose for which units of the National Wildlife Refuge System are established" (50 CFR Part 29). The question of whether or not a 100-kV transmission line is compatible with the purpose for which any given unit of the Wildlife Refuge System was established must be answered on a unit-by-unit basis. However, because of the volatile and politically sensitive nature of the decision-making process involved with obtaining an easement across USFWS refuges, these lands are designated as exclusion areas.

2) USFWS Wildlife Easements. These lands are administered as part of the USFWS Wildlife Refuge system (as defined in 50 CFR Part 29) and, as such, are managed under the set of regulations governing Wildlife Refuges. Therefore, the set of justifications for including Wildlife Refuges as exclusion areas are applicable to USFWS Wildlife Easements.

3) USFWS Identified "Critical Habitat" for Threatened or Endangered Species. The Endangered Species Act of 1973 calls for the conservation of what is termed "Critical Habitat"...specific geographic locations an endangered or threatened species needs for survival. The process for determining critical habitat is similar to that for listing species and follows a rule-making process published in the Federal Register. The law requires all federal agencies to ensure that their actions (or actions funded or authorized by them) do not adversely affect critical habitat. The major action required of federal agencies for private power line siting is easements for crossing federal land. In Montana, due to land ownership pattern, this is a common occurrence. Therefore, easements across federal land for a line that affectes identified critical habitat probably would be denied. In order to avoid this problem, critical habitat is identified as a fatal flaw and listed as an exclusion area.

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Table 5.3-7. Wildlife Exclusion and Avoidance Criteria: Phase I (Continued).

II. Avoidance Areas:

A. Moderate Impact Areas

1) MDFWP Wildlife Management Areas (WMA). According to the MDFWP, land ownership or control of land should not be a major wildlife concern in siting transmission lines (Malisani, 1981). Certain types of transmission facilities "could be located on MDFWP controlled lands if they did not affect the wildlife or recreational use of that property" (Malisani, 1981). The selection of lands to be purchased by the MDFWP for WMA's is based on several factors, one of which is the critical nature and/or high intensity of use by certain game species, specifically, winter range for big game and rearing areas for waterfowl (MDFWP, 1980). Since both of these areas are considered to be sensitive to transmission line siting (winter range DNRC, 1976a; waterfowl - Thompson, 1978) and the process for obtaining easements is politically sensitive in nature, WMA's are identified as moderate impact.

B. Low Impact Areas

1) Known Habitat for Threatened or Endangered Species. Seven animal species on the threatened or endangered species list occur in Montana. Endangered species are: Bald eagle, American peregrine falcon, whooping crane, black-footed ferret, northern Rocky Mountain wolf, and swift fox. The grizzly bear is threatened. Within the study area, the grizzly bear, swift fox, and northern Rocky mountain wolf do not occur (Flath, 1981); the peregrine falcon and whooping crane occur rarely (Skaar, 1980); and black-footed ferret is suspected to occur (Flath, 1981). Bald eagle wintering habitat is the only known occurrence of habitat for threatened or endangered species within the study area. The rationale for identifying this area as preferably avoided status is that federal agencies would more closely scrutinize easement requests for a transmission line corridor encountering known habitat for threatened or endangered species and may attach stipulations to the easement to ensure the eagle habitat is not disturbed. The basis for this concern is that federal agencies must ensure that their actions (or actions funded or authorized by them) do not adversely affect threatened or endangered species (50 CFR Part 17).

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Table 5.3-7. Wildlife Exclusion and Avoidance Criteria: Phase I (Concluded).

2) Big Game Important Habitat. Severe winter concentration areas, as defined and mapped by the MDFWP (Mussehl, 1981) for mule deer, white-tailed deer, elk, and antelope, were identified for preferably avoided status. Winter concentration areas are somewhat sensitive to HVTL siting due to impacts from: 1) road construction and subsequent vegetation removal (DNRC, 1976a); 2) off-road vehicle traffic and subsequent vegetation destruction (DNRC, 1976a); 3) maintenance activities during the critical winter months; and 4) increased access and consequent increases in animal-human interaction.

3) Mountain Goat Habitat. Mountain goats in Montana are found associated with high mountain areas dominated by alpine vegetation (Hoffmann and Pattie, 1968). This habitat is sensitive to transmission line siting because short growing seasons and shallow soils make reclamation of roads or excavation areas difficult.

4) Dense Stands of Mature Forest Habitat. Early studies of transmission line rights-of-way (ROW) through forested areas may have overemphasized the beneficial effects to wildlife of increasing the edge within a forest system and increasing forage production through overhead canopy removal (Thompson, 1977). Another proposed beneficial effect from ROW clearing includes increased hunter access. However, more recent studies conclude that these postulated benefits will, in most cases, be offset by the impacts of decreasing the amount of security, changes in the microclimate, removal of hazard trees (snags), and that postulated benefits, such as, increased forage production rarely comprise a significant amount in the overall available forage for a particular species (Thompson, 1977). Even though the potential impacts of ROW clearing on wildlife are site-specific and highly variable, the impacts that do occur are difficult to mitigate. This difficulty in mitigation caused this criteria to be selected for low impact status.

Therefore, visual concerns are included only indirectly in the Phase I exclusion and avoidance criteria.

The Western Analysis report is incorporated by reference and submitted in its entirety as Supplemental Report No. 3. Avoidance and exclusion criteria are summarized in Table 5.3-8.

5.3.1.3 Prehistoric, Historic and Paleontological Resources

The Phase I cultural resources study was conducted by Historical Research Associates (HRA) within the confines of the general study area (Caywood et al., 1982). The study consisted of a systematic reconnaissance inventory of prehistoric, historic and paleontological sites (cultural resources) that could be adversely affected by centerline placement. Phase I activities focused upon avoidance criteria and were based upon an intensive study and evaluation of available documentary data.

The State Historic Preservation Office (SHPO) recommended the study be designed to "...let preservation professionals make a judgement on whether any given corridor contains cultural resources of a kind, frequency, or nature to recommend avoidance rather than mitigation." (Sherfy, 1981).

The National Register criteria (36 CFR 60.6) and the Criteria of Effect and Adverse Effect (36 CFR 800.3) were also considered for the development of the following avoidance categories.

5.3.1.3.1 Exclusion Areas

Exclusion areas are those for which impact cannot be mitigated and that should be avoided. Very few of the sites compiled during Phase I fell into this category. An example

Table 5.3-8. Socioeconomic Exclusion and Avoidance Criteria: Phase I.

I. Exclusion Areas:

1) Wilderness Study Areas. These areas satisfy exclusion criteria because construction of transmission lines across such an area is not compatible with preservation of the area in its natural state and would be prohibited by law if the area becomes a wilderness area.

2) Land Within One-Half Mile of Airports and Landing Fields. Transmission lines built close to landing strips represent a hazard to aircraft.

3) Designated Recreation Areas. All of these areas are used for outdoor recreation in a basically natural setting. The line could represent a major intrusion.

II. Avoidance Areas:

1) Irrigated Crop Land. Transmission lines may interfere with dams, sprinkler systems and other irrigation equipment. (Differentiation between types of irrigation systems is discussed in Phase II, Section 5.4.2.2.)

2) Residential Areas. Impacts on residential areas is a major concern of residents surveyed.

3) Non-Designated, Sensitive Recreation Areas. Some areas not specifically reserved for recreation are heavily used for outdoor recreation. Visual intrusion of a transmission line may be significant enough to warrant avoidance status to such areas.

of this site type would be a pictograph inside a rock shelter. This site type derives significance not only from the physical remains present, but also from its setting and feeling. Destruction of the physical remains may be mitigated through systematic data retrieval; however, the loss of the setting for these data is irretrievable.

5.3.1.3.2 Recommended Avoidance Areas

Most of the sites compiled during this review fall into this category. The following site categories are included:

1) Sites that have been recommended as eligible for nomination to the National Register of Historic Places, or already on the Register (except those for which mitigation of adverse effect is not feasible);

2) Sites for which preliminary field work is completed, but which need additional work in order to determine significance (i.e., relocation, controlled surface testing, subsurface testing);

3) Sites indicated on historic maps or other documents but which have not been field checked (the majority of these are historic sites); and

4) Sites for which insufficient information has been recorded on the site form to determine significance.

One area of paleontological significance is included in this category. Even though there are no known sites, fossil-yielding formations are known to outcrop in the area.

5.3.1.3.3 Non-Avoidance Areas

Sites in this category are those recommended as ineligible for the National Register by the field recorder. Site forms were carefully reviewed to determine if adequate investigation had been completed at the site to warrant the recommendation. An "adequate" investigation from the standpoint of this project includes mapping of the site, subsurface testing, statements concerning the present environmental setting, condition and integrity of the site, and a description of cultural material present at the site. Not all sites recommended as ineligible are included in this category; many site forms do not contain complete information, and were placed in the recommended avoidance category. Most of the sites included in the non-avoidance category were recorded by Bureau of Land Management archaeologists following systematic data retrieval methods. Also included in this category are several sites which have been destroyed by excavation. Recommendations concerning disposition of these sites will have to be reviewed by the State Historic Preservation Office.

This preliminary ranking of siting options was based solely upon known cultural resources, without field verification. Further investigation of these sites may lead to the identification of additional exclusion areas. Also, many sites for which significance has not yet been determined will probably be found ineligible for nomination to the National Register of Historic Places and will be recategorized as non-avoidance areas.

5.3.2 Exclusion and Avoidance Areas Identified

Most of the data used for the Phase I analyses were collected from secondary sources and mapped on a common scale (½" = 1 mile) for all resource groups. Information was not collected for those resources not expected to be impacted.

5.3.2.1 Natural Resources

5.3.2.1.1 Climate

No relevant exclusion or avoidance criteria.

5.3.2.1.2 Air Quality

No relevant exclusion or avoidance criteria.

5.3.2.1.3 Geology

No areas matching the exclusion criteria in Table 5.3-1 were found within the study area. Likewise, no areas were found that met the criteria for moderate impact areas. Of the categories described in Table 5.3-1, areas of planned, possible, or existing resource developments were identified and mapped (Resource Map No. 1, Volume II).

Past and present mines of gypsum, coal, and gravel are located in the northwest, northcentral, southcentral and central portions of the study area--cost of relocating transmission lines could affect the profitability of a mining venture. Due to the combination of local geology and groundwater patterns, the possibility of slumping and landslides exists in these areas which could impact the reliability and maintenance of the transmission line.

The southcentral portion of the study area contains mainly sand and gravel deposits (found along Highway 191 from Judith Gap to the junction of route 200). Gypsum and oil shale is contained within the Heath Formation, located on the northern flanks of the Big Snowy Mountains.

Colorado Shale, the geologic feature most commonly associated with saline seep development, exists in the north and south-west third of the study area as well as the northeast corner and southeast portion.

5.3.2.1.4 Soils

Exclusion areas, as discussed in Section 5.3.1.1.4, were not identified in the study area.

Landtypes subject to moderate impact by the proposed line are listed in Table 5.3-2 and are shown in Resource Map No. 2, Volume II, as mapping units M10 and P3. Low impact areas are also shown on this map as Units A2, F5, F7, M6, P6 and P7.

5.3.2.1.5 Hydrology

The only moderate impact areas (Table 5.3-3) found to exist within the study area are bodies of standing or running water too large to span (greater than 1,000 feet), of which there are seven. It is not possible to span these water bodies using conventional design or construction practices normally used for 100-kV transmission lines.

Of the low impact criteria (Table 5.3-2), wetlands and ponds were identified and mapped on Resource Map No. 1, (Volume II). The areas mapped are all less than 40 acres.

5.3.2.1.6 Water Quality

No exclusion criteria or moderate impact criteria are noted in Table 5.3-4.

Only surface waters approaching, actually reflecting, or exceeding regulated pollution levels were mapped as low impact areas as shown in Resource Map No. 3, Volume II.

5.3.2.1.7 Aquatic Biota

No aquatic biota exclusion criteria were established for this study.

For moderate impact areas, no specific sampling locations for either the snapping turtle or spiny softshell turtle (both known and sensitive species of special interest or concern) were gleaned from a literature review. Furthermore, the pallid sturgeon (a known sensitive, aquatic vertebrate of special interest or concern) appears to be primarily associated with the mainstem Missouri and Yellowstone rivers (Holton, 1980).

Inspection of the statewide stream evaluation map indicates no "highest-value fishery resources" are present within the study area (USFWS, 1980b). No significant changes in stream classification have occurred within the study area since this map was published (Holton, 1981).

It is not likely the paddlefish or sicklefin chub (listed in Table 5.3-5 as low impact) exist within the study area (Brown, 1971; Konizeski, 1977; USDI BLM, 1971). However, that stretch of Big Spring Creek ranging from the State fish hatchery to approximately 2.5 miles downstream of West Lewistown has been classified by the MDFWP as possessing a "high priority fishery resource" (USFWS, 1980b) (see Resource Map No. 3, Volume II).

Another low impact area is the Judith River Drainage which is classified B-1, with the exception of Big Spring Creek from the Mill Ditch headgate to the Judith River, and the Judith mainstem from Big Spring Creek to the Missouri River. These two segments are classified B-2 (MDHES, WQB, 1980). (For a description of the B-1 and B-2 classifications, see Page 3-32, Supplemental Report No. 2). Those stream

stretches within the Judith River Basin with dewatering or streambank erosion problems are illustrated in Resource Map No. 3, Volume II.

The Musselshell River from Hopley Creek to Flat Willow Creek drainage is also a low impact area and is classified B-2. The remainder of the Musselshell River carries excessive sediment and, as stream bank erosion is a major contributor of such sediment (Pederson, 1980), it is recommended as a low impact area. This stretch of the river also is shown in Resource Map No. 3, Volume II.

5.3.2.1.8 Land Cover

As shown in Table 5.3-6, there are no exclusion areas for this category. Moderate impact areas include: 1) scree and Alpine turf - available in the high reaches of the Big Snowy Mountains; and 2) lakes and reservoirs greater than 40 acres or greater than 1,000 foot span (Resource Map No. 4, Volume II). There are three such bodies of water within the study area: Lake Mason, northwest of Roundup in the Lake Mason NWR; Crystal Lake, in the northwest Big Snowy Mountains; and Ackley Lake, southwest of Hobson (see exclusion area criteria for wildlife under Section 5.3.2.1.9 in regard to Lake Mason).

Dense, mature forest stands are classified as low impact and are found in the Big Snowy and Little Belt mountains (Resource Map No. 4, Volume II).

5.3.2.1.9 Wildlife

The following wildlife information is shown on two maps; one map (Resource Map No. 5) shows impact severity, while the second map (Resource Map No. 5A) shows the origin of those impacts.

Two of the three exclusion types identified in Table 5.3-7 occur in the study area: 1) USFWS wildlife refuges, and 2) USFWS wildlife easements. Both categories are mapped as a single unit in Resource Map No. 5, Volume II, with the designation of one (1). Lake Mason National Wildlife Refuge near Roundup is unsuitable for transmission line siting since the area is used as waterfowl production and migration habitat. These are the only USFWS controlled lands found within the study area (Barnes, 1981).

Currently there are no lands within the State of Montana designated as "Critical Habitat" for threatened or endangered species (Kaumheimer, 1981).

Only one moderate impact area (Table 5.3-7), wetlands, occurs within the study area. Wetland areas greater than 40 acres are identified as moderate because of the sensitivity of waterfowl to the presence of transmission lines (Thompson, 1977). (Forty acres were selected as the area minimum due to mapping scale limitations). There are a few standing water wetlands greater than 40 acres, the majority of which are in the vicinity of Lake Mason. Other comparably-sized wetlands are scattered throughout the study area. Orthophotoquads (1:24,000) from the USGS were examined and areas appearing to be permanent or seasonal wetlands greater than 40 acres were mapped (Resource Map No. 5A, Volume II).

The Judith River is a wintering area for bald eagles, the only known and consistent occurrence of a threatened or endangered species within the study area (Ayers, 1981; Seth, 1981). The Judith River meets the criteria listed in Table 5.3-7 for low impact areas and is shown in Resource Map No. 5A (Mapping Unit 8) as a moderate impact area and as a low impact area in Resource Map No. 5, Volume II.

Big game wintering habitat was identified as a low impact, but preferably avoided area due to the disturbance of wintering big game animals. Areas identified by the BLM (USDI, BLM, 1978) and MDFWP (Mussehl, 1981) as severe winter concentration areas for mule deer, elk, and antelope are shown in Resource Map No. 5A (Volume II).

Mountain goat habitat was also selected as a potential low impact area (sensitivity of goats, fragile alpine habitat). Three areas are known to exist in the Big Snowy Mountains and are mapped as unit twelve (12) in Resource Map 5A, Volume II.

Dense stands of forest habitat are included as potential low impact areas. For the purpose of this study, areas identified by the Montana Department of Community Affairs (1977) as commercial forest are mapped as dense stands of forest habitat.

5.3.2.2 Socioeconomic Resources

Socioeconomic exclusion and avoidance areas are shown in Resource Map No. 6 (Volume II). The Big Snowy Mountain Wilderness area, three public and 19 private airports (including a ½-mile buffer around each), and several designated recreation areas meet the exclusion area criteria. Mechanically irrigated lands, cities and towns, subdivisions, and the Little Snowy Mountain portion of the Lewis and Clark National Forest are included as avoidance areas.

5.3.2.3 Prehistoric, Historic and Paleontological Resources

A total of 287 sites were identified; only four of these were categorized as exclusion areas. The majority of sites (239) were assigned to the recommended avoidance category; the

non-avoidance category contains 44 sites. Because of the confidential nature of site locations, this information is being submitted to DNRC in a separate document which is exempt from the Freedom of Information Act [U.S.C. 552(b)].

5.3.3 Comparison of Corridor Alternatives

The comparison of the four alternative corridors is based upon evaluation of three major considerations: 1) the estimated cost of construction of a line in each of the four corridors; 2) the system operation characteristics of a line built in each of the four corridors; and 3) the expected environmental impacts of building and operating a line in each of the four corridors.

5.3.3.1 Installation Cost Impacts

Costs for building the line in each of the four corridors are shown in Table 5.3-9.

Table 5.3-9. Estimated Construction Cost By Option: Phase I.

OPTION		CONSTRUCTION COST (84$'s)
Option No. 1	(Roundup)	$7,889,750
Option No. 2	(Stanford)	$7,432,700
Option No. 3	(Benchland)	$7,065,900
Option No. 4	(Judith Gap)	$6,088,500

Option No. 4 is the cheapest to build, costing $977,400 less than the next cheapest alternative. Supporting information for these estimates can be found in Exhibit K, Volume III.

5.3.3.2 Transmission System Operating Performance Impacts

The four transmission corridor options were compared in terms of operating performance. The studies included in Exhibit B show Option No. 4 will maintain the highest voltage levels for the majority of outage conditions considered. Option No. 4 also will provide adequate service for a longer time into the future and will result in smaller overall line losses than will any of the other three options. When system losses in the Central Montana Area were compared for each of the four options, the Judith Gap 230-kV Tap had the lowest losses. The losses for each of the four options are compared to system normal during the 1984 heavy winter condition in Table 5.3-10.

Table 5.3-10. Comparison Of Line Losses By Option: Phase I.

OPTION	LOSSES (MW)	DIFFERENTIAL LOSSES TO EXISTING SYSTEM NORMAL
Existing System Normal	25.8	0
No. 1	21.6	4.2
No. 2	16.9	8.9
No. 3	16.4	9.4
No. 4	15.4	10.4

Option No. 4 is clearly preferred based on operational considerations.

5.3.3.3 Environmental Impacts

5.3.3.3.1 Natural Resource Impacts

- Geology

The four options are rated based on geologic criteria in Table 5.3-11. This rating is based on an analysis of the exclusion and potential impact criteria (Table 5.3-2) existing within the study area. Results are shown on Resource Map No. 1, Volume II. A straight line route from the potential route end points was considered for each option, and the number of potential impact areas crossed were noted. The number of miles or the number of potential impact areas crossed were included in the ratings. (All natural resource disciplines were evaluated in this manner.)

Table 5.3-11. Option Rating Based on Geologic Criteria: Phase I.

RATING	OPTION[a]
First	4 (Judith Gap)
Second	1 (Roundup)
Third	3 (Benchland)
Fourth	2 (Stanford)

[a] Options are described in Section 3.1.2.4.

- Soils

The information contained in Section 5.3.1.1.4 was evaluated on the assumption the optimal corridor would encounter a minimum number of potential impact areas over the shortest

distance between designated transmission line endpoints. Further, suitability evaluations were made by comparing the variability in expected sedimentation rates (i.e., in tons per square mile/year for drainage basins greater than 100 square mile) among the potential corridors (Donahue and Ashley, 1973; USDI Bureau of Reclamation, 1972). Table 5.3.-12 summarizes option ratings based on soils criteria.

Table 5.3-12. Option Rating Based on Soils Criteria: Phase I.

RATING	Option[a]
First	3 (Benchland)
Second	4 (Judith Gap)
Third	2 (Stanford)
Fourth	1 (Roundup)

[a] Options are described in Section 3.1.2.4.

- Hydrology

The four options are ranked by hydrologic criteria in Table 5.3-13 (refer to Table 5.3-3 for criteria).

Table 5.3-13. Option Rating Based on Hydrologic Criteria: Phase I.

RATING[a]	OPTION[b]
First	4 (Judith Gap)
Second	3 (Benchland)
Third	2 (Stanford)
Fourth	1 (Roundup)

[a]The rating evaluation for Options No. 3 and No. 4 judged these options to be essentially equal as no hydrologic concerns as defined in Table 5.3-3 were identified within these portions of the study area. A ranking of 1.5 is used for each in Table 5.3-18.

[b]Options are described in Section 3.1.2.4.

- Water Quality

All corridors are rated in Table 5.3-14 based on the occurrence of water quality criteria within the study area as defined in Table 5.3-4.

Table 5.3.-14 Option Rating Based on Water Quality Criteria: Phase I.

RATING	OPTION[a]
First	1 (Roundup)
Second	4 (Judith Gap)
Third	3 (Benchland)
Fourth	2 (Stanford)

[a]Options are described in Section 3.1.2.4.

- ## Aquatic Biota

The Applicant decided transmission line options could best be evaluated by comparing: 1) the relative number of streams potentially crossed per line option and the quality of associated fisheries; and 2) the number of times each option encounters a stream suffering from bank erosion and/or dewatering. Table 5.3-15 rates the options based on aquatic criteria.

Table 5.3-15. Option Rating Based on Aquatic Biology Criteria: Phase I.

RATING	OPTION[a]
First	3 (Benchland)
Second	4 (Judith Gap)
Third	2 (Stanford)
Fourth	1 (Roundup)

[a]Options are described in Section 3.1.2.4.

- ## Land Cover

Options were evaluated for potential impact by appraising each option for possible encounters with sensitive land cover classes. Table 5.3-16 rates each option based on land cover criteria.

Table 5.3-16. Option Rating Based on Land Cover Criteria: Phase I.

RATING	OPTION[a]
Second[b]	4 (Judith Gap)
Second	2 (Stanford)
Second	3 (Benchland)
Fourth	1 (Roundup)

[a]Options are described in Section 3.1.2.4.

[b]The rationale for assigning second ratings to the three options judged to be of equal (but less impact than Option No. 1) sensitivity to transmission line siting was as follows: the sum of rating one, two, three, and four is 10. If four is subtracted from 10, the difference is six. Spreading the remaining rating space (six) equally between the three equally sensitive options given them each ratings of two (i.e., six divided by three equals two).

- Wildlife

Criteria used for rating the four options included: 1) the number of deviations from a straight line needed to avoid exclusion areas; 2) the number and types of impact areas crossed; and 3) the number of deviations from a straight line necessary to avoid impact areas. Ratings for the four options are presented in Table 5.3-17.

Table 5.3-17. Option Rating Based on Wildlife Criteria: Phase I.

RATING	OPTION[a]
First	3 (Benchland)
Second	2 (Standford)
Third	4 (Judith Gap)
Fourth	1 (Roundup)

[a]Options are described in Section 3.1.2.4.

• Integration of Natural Resource Impacts

Each option considered by the Applicant for providing additional power to the Glengarry substation was rated in terms of potential impact on each of the natural resource disciplines. Table 5.3-18 presents a summary of the ratings assigned to each option by discipline. Ratings are from one to four (least to greatest potential impact), showing <u>relative</u> differences between options, not <u>quantitative</u> differences. The rationale for assigning equal ratings is presented in Table 5.3-16.

Table 5.3-18. Integration of Natural Resources Corridor Impacts: Phase I.

NATURAL RESOURCE	OPTION RATINGS[b]			
	Option No. 1	Option No. 2	Option No. 3	Option No. 4
Geology	2[a]	4	3	1
Soils	4	3	1	2
Hydrology[c]	4	3	1.5	1.5
Water Quality	1	4	3	2
Aquatic Biota	4	3	1	2
Land Cover[c]	4	2	2	2
Wildlife	4	2	1	3
TOTAL[d]	23	21	12.5	13.5

[a]Rating numbers were assigned via discipline-specific methods. These are described in each discipline impact assessment section. Ratings are from 1 to 4, with 1 having the least potential impact and 4 having the most. These numbers show relative differences between options, not quantitative differences (i.e., 2 is not twice as susceptible to impact as 1).

[b]Option end-points are described in Section 3.1.4.2.

[c]See Table 5.3-13 for rating assignment rationale.

[d]Totals indicate a sum of the option ratings for each natural resource shown. No attempt was made to weight the relative importance of each natural resource category. Theoretical totals using this method range from 7 (least potential impact) to 28 (greatest potential impact).

5.3.3.3.2 Socioeconomic Resource Impacts

Socioeconomic inventory data were supplemented by a survey of landowners in the four study corridors. More detail on criteria, data inventory, and the landowner survey is included in Supplemental Report No. 3. Overall socioeconomic ranking of the four options is shown in Table 5.3-19.

Table 5.3-19. Option Rating based on Socioeconomic Criteria: Phase I.

RATING	OPTION[a]
First	4 (Judith Gap)
Second	1 (Roundup)
Third	2 (Stanford)
Fourth	3 (Benchland)

[a]Options are described in Section 3.1.2.4.

Option No. 4 is ranked first because it contains no major exclusion or avoidance areas and offers the best opportunity for minimizing adverse impacts. Option No. 1 is ranked second; it involves very little irrigated land, but encompasses the largest single avoidance area (the Little Snowy Mountains) and the largest single exclusion area (Big Snowy Mountain Wilderness Study Area).

Options No. 2 and No. 3 are ranked third and fourth, respectively. Both options contain private landing fields and numerous irrigated areas along the Judith River and its tributaries. The survey of landowners revealed strong landowner opposition along both Option No. 2 and No. 3, with Option No. 3 eliciting the stronger reaction.

5.3.3.3.3 Prehistoric, Historic, and Paleontological Resource Impacts

Because so few cultural resource inventories have been completed in the study area, it is difficult to rate the proposed options in terms of preference (Howard, 1979). This is especially difficult because the options are not defined corridors--they are considered general areas between two defined end points. One option may appear to affect fewer cultural resource sites than another because no surveys have taken place between the established end points. This is especially true for prehistoric sites--the entire northwest quarter of the study area lacks recorded prehistoric sites.

Keeping these constraints in mind, Table 5.3-20 presents a rating of the proposed options based on cultural resource criteria.

Table 5.3-20. Option Rating Based on Cultural Resource Criteria: Phase I.

RATING	OPTION[a]
First	2 (Stanford)
Second	3 (Benchland)
Third	1 (Roundup)
Fourth	4 (Judith Gap)

[a]Options are described in Section 3.1.2.4.

Thirteen historic sites appear to lie between the end points of Option No. 2; no paleontological or prehistoric sites were located near the area. It does not appear construction and operation of a transmission line within this corridor would adversely impact cultural resources.

Twenty-one historic sites, and no paleontological or prehistoric sites, were identified for Option No. 3. Most of the historic sites require field verification--many may be reclassified as non-avoidance. Option No. 3 does not appear to significantly affect cultural resources.

A significant number of prehistoric and historic sites (51), as well as an area of paleontological significance, lie between the end points of Option No. 1. One exclusion area lies within the general area of the option. This is a small site which could easily be avoided; however, there appears to be a fairly high site density in the area, both prehistoric and historic, and mitigation of impact to sites may be prohibitive in terms of time and cost.

Of all the proposed alternatives, Option No. 4 appears to pose the most problems in terms of cultural resources. Twenty-five historic sites, including homesteads and roads, have been identified in the area. The Judith Basin was established as an early population center (Lewistown dates to the 1870s); it was densely homesteaded and several small historic communities are located between the end points of this option.

The Judith Gap is significant prehistorically as well as historically, as the major pass between the Musselshell Drainage to the south and the Judith Basin to the north. There are no currently known prehistoric or paleontological sites within the area of Option No. 4.

Although none of the sites located in the general area of this option have been categorized "unmitigable," the frequency and extent of action necessary to mitigate adverse effect to these sites could be substantial in terms of time and cost.

5.3.4 The Selected Candidate Corridors

The four corridors were compared using the five categories listed in Section 5.3.3. Based on reconnaissance-level data used in the Phase I comparison, Options No. 4 and No. 3 appear strongly preferable to either Options No. 1 or No. 2 for all categories except the archeological, historical, and paleontological resources. Because the reconnaissance-level inventory of the archeological, historical, and paleontological resources shows a very uneven data base (i.e., archeological sites noted more closely describe areas surveyed than the existing resource), and because most potential impacts to these resources can be mitigated through careful centerline and structure placement, the selection of candidate corridors puts more weight on the other categories.

Phase I analysis led to the decision to retain Options No. 3 and No. 4 for intensive investigation, and to drop Options No. 1 and No. 2 from further consideration. Options No. 3 and No. 4 are thus the candidate corridors.

5.3.4.1 General Comparison of Candidate Corridors

Based upon reconnaissance-level data, Option No. 4 seems strongly preferable to Option No. 3. The main advantage of Option No. 4 is fewer miles of line construction as reflected in the substantially smaller construction costs, fewer miles of land crossed, and superior electrical characteristics. However, because the reconnaissance-level data are too general to use for comparison of alternative reference centerlines, Option No. 3 is retained, subject to comparison based on more refined avoidance criteria and a correspondingly more intense data inventory.

5.4 Phase II: Selection of the Preferred Route

The objective of the Phase II analysis is to pick alternative routes within the candidate corridors selected in Phase I, compare those alternative routes, and choose the best route alternative. These alternatives are compared in terms of costs, operating characteristics and environmental (natural, socioeconomic and cultural) impacts. [See Page 53 for limitations.]

The Phase II study area consists of candidate corridors (options) No. 3 and No. 4 (Figure 5.4-1). The study area is in the shape of the letter L rotated 180 degrees, and contains approximately 450 square miles.

5.4.1 The Alternate Routes Selected

Preliminary reference centerlines were chosen for the four alternative routes. Selection of these preliminary routes was based on general information of the two candidate corridors from the Phase I mapping supplemented by aerial reconnaissance and ground checking. Use of existing corridors was a substantial factor in the placement of three of the four routes.

The preliminary reference centerlines were adjusted as aerial photography and large-scale (1:24,000) land use mapping was completed. The final reference centerlines are shown in Figure 5.4-1. Three alternative routes are within the Judith Gap-to-Glengarry candidate corridor (Option No. 4, Phase I), and the fourth is within the Benchland-to-Glengarry candidate corridor (Option No. 3, Phase I). All four routes were

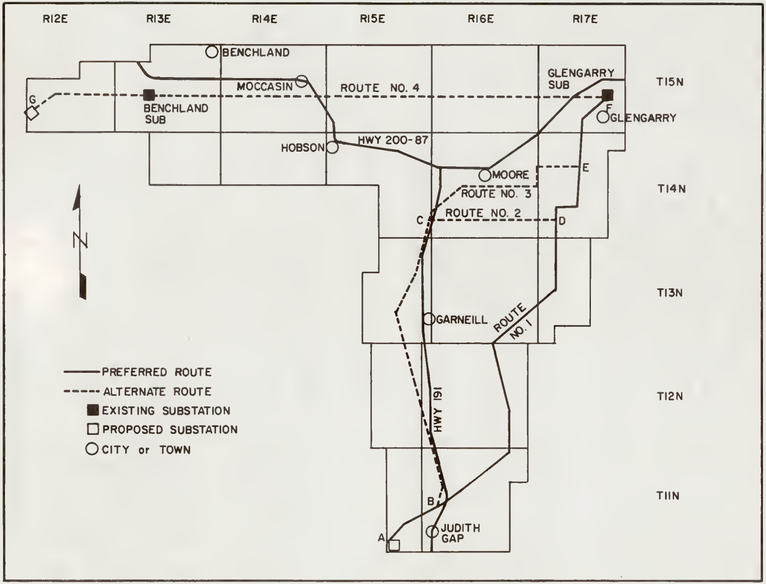

Figure 5.4-1. Phase II Study Area Showing Four Route Alternatives.

evaluated in terms of natural, socioeconomic, and cultural resources [see Page 53 for limitations]. These comparisons, combined with Phase I cost and operating characteristic comparisons, showed Route No. 4 (Benchland-to-Glengarry) to be distinctly inferior to Routes No. 1, No. 2, and No. 3; no further work was done on Route No. 4. Additional analyses performed on the remaining routes include analysis of communication impacts (Supplemental Report No. 4), revised cost estimates (Exhibit K, Volume III), and a detailed route description (Exhibit H, Volume III).

5.4.1.1 Brief Description of Alternate Routes

The location of reference centerlines for the four routes compared in Phase II are shown in Figure 5.4-1. The routes are identified as follows:

Route No. 1 (ABDEF);
Route No. 2 (ABCDEF);
Route No. 3 (ABCEF); and
Route No. 4 (GF).

5.4.1.1.1 Route No. 1

Route No. 1, the preferred route, lies furthest east and traverses a high percentage of range land (approximately 18 miles). It is approximately 32 miles long and, over much of its length, is several miles from any existing rights-of-way.

5.4.1.1.2 Route No. 2

Route No. 2 is approximately 37 miles in length and parallels existing rights-of-way for the major portion of its length. In the southern reaches, it parallels an existing railroad right-of-way; it parallels county roads to the north.

5.4.1.1.3 Route No. 3

Route No. 3, about 36 miles in length, is identical to Route No. 2 for much of its length, and follows an existing railroad right-of-way about three miles further before paralleling county roads.

5.4.1.1.4 Route No. 4

Route No. 4 travels northeast from the Great Falls-to-Broadview 230-kV line to the Benchland Substation, then east to the Glengarry Substation. For much of its length, Route No. 4 parallels section lines and the existing Benchland-to-Glengarry 100-kV line. The length of this line is approximately 42 miles (including 14 miles for a seven-mile double line segment between Benchland and the Great Falls-to-Broadview 230-kV line).

5.4.2 Exclusion and Avoidance Criteria

The Phase II comparison of route-specific impacts was begun by reviewing the exclusion and avoidance criteria used in Phase I; some criteria were left unchanged, some were dropped, and new criteria were added. The resulting set of criteria used for Phase II is a more focused list as described in the following subsections.

5.4.2.1 Natural Resources

The same definitions for exclusion, moderate impact, and low impact given in Phase I (Section 5.3.1) were used in Phase II. Likewise, most of the natural resource exclusion and avoidance criteria used in Phase I were brought forward to Phase II unchanged; this is the case for climate, air quality, geology, hydrology, water quality, aquatic biota

and land cover. Soil series information was included in the analysis of soils impacts, and the analysis of wildlife impacts was expanded to include wetlands greater than 40 acres with waterfowl concentrations being added as an avoidance area (moderate impact) due to the potential for waterfowl line strikes.

5.4.2.2 Socioeconomic Resources

Socioeconomic avoidance and exclusion criteria for Phase II included airports and landing fields, recreation areas, irrigated croplands, and residential areas from Phase I. Wilderness study areas do not exist within the Phase II study area and were therefore dropped as an exclusion criterion. The avoidance category of irrigated cropland was further split to differentiate between wheel-line, center pivot and big gun irrigation systems. Flood irrigation was excluded from the irrigation category and included in a single "dry cropland" category (because expected impacts are equivalent). Missile silos were added as a new exclusion feature and existing rights-of-way (railroads, highways, pipelines and transmission lines) were added as an "attraction" category (other things being equal, joint use of corridors is usually desired from a land use perspective).

Visual concerns were included explicitly for the first time in Phase II. Avoidance and exclusion criteria for visual resources are based on results of the Phase I study (Supplemental Report No. 3). Areas with visual significance are considered avoidance areas but are given a low-impact rating because the impacts are largely mitigable by centerline selection and because the study area, in general, does not have outstanding scenic quality.

Avoidance areas for visual resources include areas of high visibility (i.e., viewed by many people) and areas with high scenic quality. High visibility areas include transportation rights-of-way, residences, and identifiable observation points; areas with high scenic qualities include areas that have undeveloped, unique, or pristine qualities.

Visual impacts can be of several types and of varying intensity. A transmission line may not produce the same kind or degree of impact on two different persons or even on one person at two different times:

> "One's visual expectation of an area or scene and aesthetic appreciation is determined by that person's experiences, education, values, and purpose for being there. Therefore, visual impact assessment is not an exact function and its evaluation is largely subjective." (DNRC, 1976c).

Visual impact, either positive or negative, is produced when people see what they do not expect. Although persons would not expect to see a transmission line along portions of Route No. 1 (Section 5.4.4.4.1), centerline selection can reduce the visibility of the line. The visual impact of a line can be mitigated by avoiding skylines, increasing distance from observation points, blending the line with the landscape, and using the character of the landscape to "hide" the line.

Communications systems impacts were evaluated for the three Routes (No. 1, No. 2, and No. 3). This evaluation is detailed in Supplemental Report No. 4.

5.4.2.3 Prehistoric, Historic and Paleontological Resources

Historic Research Associates (HRA) conducted a field reconnaissance of the candidate corridors to identify generic cultural resource site categories for the Phase II study

(Caywood et al., 1982). The site categories provided the framework for the exclusion and avoidance criteria developed by the Applicant.

Because little additional information concerning paleontological or prehistoric sites was gained from this research, these site types were not included in the criteria development. There are no geologic formations likely to yield significant paleontological remains; only three prehistoric sites were identified within the study area (trail, bison jump, campsite), and no formal cultural resource studies had been conducted in the area previously. There are insufficient data for a route-specific estimate of prehistoric sites for this project.

A total of 65 historic sites made up the data base for site categorization. (See the cultural resources report [Caywood et al., 1982] for a full discussion of the qualities of significance for each site type). Because of the confidential nature of site location information, the report is being submitted to DNRC as a separate document which is exempt from the Freedom of Information Act [U.S.C. 552(b)]. Table 5.4-1 summarizes the potential historic site types in the study area. The critical qualities of significance are those both essential to eligibility for the National Register, and vulnerable to high voltage transmission line construction and operation. Engineering and architectural values incorporate integrity of workmanship, design, and materials.

Table 5.4-1. Summary of Potential Historic Sites in the Central Montana Study Area: Phase II.

SITE TYPE	CRITICAL QUALITIES OF SIGNIFICANCE
Towns	Integrity of setting and location Architectural values
Schools	
Rural	Integrity of setting and location Architectural values
Town	Architectural values
Churches	Architectural values
Homesteads, farms, & ranches	Integrity of setting and location Architectural values
Barns & granaries	Architectural values
Roads	Integrity of setting and location Engineering values
Mines	Integrity of location Engineering values

Because of the small size of most cultural resource sites (compared to a wilderness area or critical wildlife habitat), probability of direct impact is best assessed during final centerline placement. The only impact assessment attempted at the route selection stage is visual intrusion upon sites whose significance rests primarily with site setting (an indirect impact). According to the National Park Service:

> "...setting illustrates the character of the place in which the resource played its historical role. In some cases, setting serves to illustrate basic physical conditions and function. In other cases, the surroundings and the way in which the property is positioned or sited may be an integral part of

> the property itself, illustrating not only conditions or casual relationships but also concepts of nature or aesthetic preferences .... For historic sites where there were no physical cultural remains, integrity depends on the authenticity of the site and the retention of the natural setting that existed at the time of the significant event." (National Park Service 1982).

Visual intrusion upon the setting of a historic site can be avoided by transmission line placement and design. The degree of transmission line visibility can be influenced by a number of unquantifiable variables such as apparent size, contrast with surroundings, and the viewing angle (Driscoll et al., 1976). The apparent size is related to viewing distance; perception of apparent contrast can be modified by differential light intensity, shape, form, line, color, and texture. Other ephemeral conditions make prediction of visual intrusion upon setting unverifiable at the route selection stage (e.g., atmospheric clarity and seasonal variables both influence line visibility).

Three ways in which visual intrusion can be minimized are absorption, distance, and screening (Sullivan, 1982). Absorption is a placement technique that reduces the viewer's awareness of the line. One absorption method is to blend the line with the landscape; e.g., sagebrush can provide an exceptionally effective masking texture and tone (Driscoll et al., 1976). Distance reduces the visibility of the line, and screening uses the character of the landscape to "hide" the line. Existing vegetation can be used as a buffer.

Because of the potential for mitigation, visual intrusion upon a site setting cannot be considered a severe and unmitigable impact to the cultural resource environment, and therefore, it cannot be considered an exclusion criterion. The avoidance criteria include: 1) eligibility for the

National Register of Historic Places, and 2) a setting critical to significance. The non-avoidance criteria include: 1) eligibility for the National Register of Historic Places with site significance that does not rely primarily upon site setting, or 2) ineligibility for the National Register. Table 5.4-2 contains a breakdown of eligible site types into avoidance categories.

Table 5.4-2. Eligible Site Types by Avoidance Category: Phase II.

AVOIDANCE	NON-AVOIDANCE
Towns	Town Schools
Rural Schools	Churches
Homesteads, Farms & Ranches	Barns & Granaries
Roads and Trails	

These criteria were developed for the route selection process only; they do not transfer to the centerline stage of transmission line siting and impact analysis. The true value of cultural resources cannot be determined without final determination of eligibility for the National Register. Potential impact to eligible sites cannot be determined without an on-site visit to determine line visibility, etc. The real resource density of a route cannot be determined without an intensive inventory (Howard, 1979).

5.4.3 Exclusion and Avoidance Areas Identified

5.4.3.1 Natural Resources

5.4.3.1.1 Geology and Hydrology

No exclusion or moderate avoidance areas were identified for Phase II. However, for low impact, the following features were identified within the four routes: a) areas of planned, possible or existing geologic resource development(s); b) areas prone to saline seep developments (Colorado shale formations); and c) wetlands and ponds.

Mines found within the northwest and north central portions of the study area consist mainly of abandoned coal mines and abandoned and working gypsum mines. In addition to the economic consideration of placing a transmission line near tnese areas, there also exists (from a structural stability viewpoint) the possibility of slumping and landslides which could affect both the reliability and maintenance of the transmission line system. However, the active mines are underground and a transmission line should not interfere with their operation.

Colorado shale formations were mapped to show potential saline seep areas (Resource Map No. 7, Volume II). The thickness of the formation depends upon the amount removed by erosion, but it amounts to 1,500 to 2,000 feet where Colorado shale is overlain by the Eagle sandstone. Although the Colorado Formation is predominately shale, it contains several sandstone beds that yield water to wells.

Ponds and wetland are discussed in Section 5.4.3.1.8.

5.4.3.1.2 Soils

Low impact areas were the only avoidance areas identified within the four routes (Resource Map No. 8, Volume II). The low impact areas included the following USDA Forest Service

landtypes: A2-Alluvial floodplains-grasslands; M6-Slumpy Mountains; P6-Dissected Shale and Sandstone (14-20 inch precipitation zone); and P2-Dissected Shale and Sandstone Plains (10-14 inch precipitation zone).

The soils series found within the study area are shown in Resource Map No. 9, Volume II.

5.4.3.1.3 Water Quality

No exclusion or moderate impact areas were identified for this discipline in Phase II. As in Phase I, only surface waters which are approaching, reflecting, or exceeding regulated pollution levels were identified as low impact areas.

Streams within the study boundaries which meet any or all of the low impact criteria are: 1) the Judith River, 2) Ross Fork Creek, 3) Beaver Creek, and 4) Cottonwood Creek. The Judith River and Ross Fork Creek drain areas of previous or existing mining activity and much of the area is used for agriculture. Feedlot operation, saline seep, overgrazing, natural erosion, and poor logging practices may also contribute to water quality problems in these streams, which might include high levels of dissolved solid sediment, coliform, or nutrients (Kaiser and Botz, 1975; MHDES, Water Quality Bureau, 1982). Low impact areas are shown in Resource Map No. 10 (Volume II).

These streams should not pose major problems to the construction or operation of the transmission line; the use of standard engineering practices and careful construction techniques should alleviate potential impacts to stream water quality.

5.4.3.1.4 Aquatic Biota

Moderate and low impact areas were the only potential avoidance categories identified within the study area. These criteria have been specifically defined in the Phase I summary (Table 5.3-5).

With the exception of the criteria concerning species of special interest or concern, aquatic biology avoidance criteria are shown on Resource Map No. 10 (Volume II); those areas containing species of special interest or concern have not been mapped for reasons detailed in the Supplemental Report No. 2.

As detailed in Supplemental Report No. 2 (Tables 2.2.3-3 and 2.2.3-4), the aquatic vertebrate species of special interest or concern shown in Table 5.4-3 may be found in and/or around the study area.

Table 5.4-3. Aquatic Vertebrate Species of Special Interest or Concern Potentially Found in the Central Montana Phase II Study Area.

CATEGORY	SCIENTIFIC NAME	COMMON NAME
Sensitive Species:		
	Chelydra serpentina	Common snapping turtle
	Trionyx spiniferus	Spiny softshell turtle
	Scaphirhynchus albus	Pallid sturgeon
Other Species:		
	Polyodon spathula	Paddlefish
	Hybopsis meeki	Sickelfin Chub

Of the species listed in Table 5.4-3, all are found in Fergus County; none are recorded for Judith Basin County (Flath, 1981). No specific sampling locations for either the common snapping turtle or the spiny softshell turtle are available; and no record of the listed fish species is known for streams within or immediately draining the study area (Brown, 1971; Gardner and Berg, 1982; Konizeski, 1977: USDI, BLM, 1971).

In addition to the criteria listed in Table 5.3-5 of the Phase I summary, streams ranked as moderate fishery resources (Class IV) were also considered. The Judith River from near Hobson to near Ross Fork, and Beaver and Cottonwood creeks southwest of Lewistown, have been designated as Class IV (USDI, FWS, 1980b).

5.4.3.1.5 Land Cover

No exclusion or avoidance criteria were established for Phase II; a description of the vegetative land cover is included as Exhibit L, Volume III .

5.4.3.1.6 Wildlife

Moderate and low avoidance impacts are the only wildlife areas identified within the four routes. Moderate avoidance impacts consist of waterfowl concentration areas, predominately wintering mallards (Anas platyrhynchos). In addition, blue herons (Ardea herodias) and sandhill cranes (Grus canadensis) are associated with the waterfowl concentration sites. Resource Map No. 11 (Volume II) depicts waterfowl and bald eagle (Haliaeetus leycocephaus) wintering concentration areas along with mule and white-tailed deer (Odocoileus heminous, O. virginianus) winter range. Bald eagle wintering areas and deer winter range were evaluated as having a low impact. In addition, one wetland greater than 40 acres was identified.

The study area consists of a number of small wetlands (less than 10 acres) used by waterfowl. For a list of waterfowl potentially found in the area, see Table 5.4-4. The bald eagle wintering areas were documented by the Montana Fish, Wildlife and Parks (Watt, 1982).

Table 5.4-4. Waterfowl Potentially Found in the Central Montana Study Area.

SPECIES	STATUS[a]
Mallard	W,B
Gadwall	B
Pintail	B
Green-Winged Teal	b
Blue-Winged Teal	B
Cinnamon Teal	B
American Teal	b
Northern Shoveler	B
Redhead	B
Ring-Necked Duck	t
Canvasback	b
Lesser Scaup	B
Common Goldeneye	t
Barrow's Goldeneye	t
Bufflehead	t
Surf Scoter	t
Ruddy Duck	b
Hooded Merganser	t
Common Merganser	B
Red-Breasted Menganser	l

[a]"B" denotes the species is known to breed in the area's latilongs.
"b" denotes the species is suspected of breeding in the area's latilongs.
"t" denotes the species occurs, but no evidence of breeding.
"l" denotes records are probably referable to this latilong.

5.4.3.2 Socioeconomic Resources

Land use data were collected from existing maps, aerial photographs, blueprints, key personnel interviews, and field checks.

The following land uses were mapped: airports and landing strips, transportation corridors, major utility lines, pipelines, population settlements, buildings, cemetaries, Minuteman missile silos/command centers, rangeland, cultivated land, and mechanically irrigated cropland. These land uses were mapped at a 1:24,000 scale and are shown in Volume II as Resource Maps No. 12A through 12M. The individual maps are combined in a composite map at a scale of approximately ½" = 1 mile scale in Resource Map No. 12. The lan use assessment completed for the Applicant by Western Analysis, Inc. is incorporated by reference and submitted as Supplemental Report No. 5.

Land uses identified as exclusion areas within the Phase II study area include 10 Minuteman missile silos/command centers, four airstrips, and several population settlements.

Of the total land within the study area, about 60 percent is cropland and 34 percent is rangeland. There are one big gun, fourteen center pivots, and three wheel-line irrigation systems in the study area.

Major transportation corridors include Highway 87 and Highway 191, and the Burlington Northern and the Milwaukee railroads.

To complete the visual assessment, photographs were taken from 39 different locations throughout the study area. The photographs show the nature and conditions of the existing landscape. Each route was also described, and potential

adverse visual impact and mitigative features identified. The photographs and visual analysis completed by Western Analysis, Inc., are included in Supplemental Reports No. 5, 6, and 7.

5.4.3.3 Prehistoric, Historic & Paleontological Resources

The results of the reconnaissance inventory of the study area are reported in a separate document (Caywood *et al*., 1982). A total of 68 historic and prehistoric sites were identified and mapped. Table 5.4-5 details the results of the impact analysis conducted by the Applicant for each two-mile wide route [see Page 53 for limitations]. Data are also presented for each route's viewshed (an additional one mile on either side of the route boundaries). The viewshed was developed to account for the potential impact of a transmission line constructed near the route boundary that visually intrudes upon sites outside the route. Viewshed data supplement the route-specific data.

Table 5.4-5. Cultural Resource Impact Assessment Data by Route [see page 53 for limitations].

SITE NUMBER	SITE TYPE	ESTIMATED ELIGIBILITY	IMPACT ASSESSMENT
Route 1:			
TFR104	Homestead	Eligible	Avoidance
TFR103	Homestead	Eligible	Avoidance
TFR64	Homestead	Ineligible	Non-avoidance
TFR112	Rural School	Eligible	Avoidance
TFR80	Farm	Ineligible	Non-avoidance
TFR78	Farm	Ineligible	Non-avoidance
TFR115	Granary	Eligible	Non-avoidance
TFR116	Granaries	Eligible	Non-avoidance
TFR113	Farm house	Eligible	Avoidance
TFR108	Farm Complex	Eligible	Avoidance
TFR6	Town	Eligible	Avoidance
(Viewshed):			
TFR81	Farm	Ineligible	Non-avoidance
TFR93	Homestead	Ineligible	Non-avoidance
TFR114	Rural School	Eligible	Avoidance
TWL5	Town	Eligible	Avoidance
TFR71	Homestead	Ineligible	Non-avoidance
TFR70	Homestead	Ineligible	Non-avoidance
Route 2:			
TJT21	Farm	Ineligible	Non-avoidance
TJT20	Homestead	Eligible	Avoidance
TFR89	Town	Ineligible (individual buildings eligible)	Non-avoidance
TFR72	Homestead	Eligible	Avoidance
TFR102	Homestead	Undetermined	Undetermined
TFR107	Barn	Eligible	Non-avoidance
TJT64	Farm complex	Eligible	Avoidance
TFR21	Town	Ineligible	Non-avoidance
TFR93	Homestead	Ineligible	Non-avoidance
TFR113	Farm house	Eligible	Avoidance
TFR108	Farm complex	Eligible	Avoidance
TFR6	Town	Eligible	Avoidance
TFR116	Granaries	Eligible	Non-avoidance
(Viewshed):			
TFR1	Trail	Ineligible	Non-avoidance
TWL5	Town	Eligible	Avoidance
TFR26	Rural school	Eligible	Avoidance
TFR106	Homestead	Ineligible	Non-avoidance
TFR111	Farm complex	Eligible	Avoidance
TFR78	Farm	Ineligible	Non-avoidance
TFR114	Rural school	Eligible	Avoidance
Route 3:			
TJT21	Farm building	Ineligible	Non-avoidance
TJT20	Homestead	Eligible	Avoidance
TFR89	Town	Ineligible (individual buildings eligible)	Non-avoidance
TFR72	Homestead	Eligible	Avoidance
TFR102	Homestead	Ineligible	Non-avoidance
TFR107	Homestead	Eligible	Avoidance
TJT64	Farm complex	Eligible	Avoidance
TFR21	Town	Ineligible	Non-avoidance
TFR116	Granaries	Eligible	Non-avoidance
TFR108	Farm complex	Eligible	Avoidance
TFR6	Town	Eligible	Avoidance
TFR20	Town	Ineligible (individual buildings eligible)	Non-avoidance
(Viewshed):			
TFR1	Trail	Ineligible	Non-avoidance
TWL5	Town	Eligible	Avoidance
TFR26	Rural school	Eligible	Avoidance
TFR106	Homestead	Ineligible	Non-avoidance
TFR93	Post office	Ineligible	Non-avoidance
TFR113	Farm house	Eligible	Avoidance
TFR114	Rural school	Eligible	Avoidance
Route 4:			
TFR6	Town	Eligible	Avoidance
TFR98	Homestead	Eligible	Avoidance
TFR99	Farm house	Ineligible	Non-avoidance
TFR100	Farm complex	Eligible	Avoidance
TJT48	Homestead	Eligible	Avoidance
TJT63	Ranch	Eligible	Avoidance
TJT32	Farm	Eligible	Avoidance
TJT30	Farm	Eligible	Avoidance
TJT4	Ranch	Ineligible	Non-avoidance
TJT7	Town	Ineligible (individual buildings eligible)	Non-avoidance
(Viewshed):			
TFR28	Rural school	Ineligible	Non-avoidance
TJT62	Farm complex	Ineligible	Non-avoidance
TFR101	Farm house	Ineligible	Non-avoidance

5.4.4 Comparison of Alternate Routes

The route alternatives described in Section 5.4.1.3 have been compared in terms of cost of installation, electrical performance and environmental impacts. Cost estimates and environmental impact estimates were both refined relative to those used in Phase I. Operating characteristics are the same as those used in Phase I.

5.4.4.1 Installation Cost Comparison

Installation cost estimates shown in Table 5.4-6 are in 1984 dollars and are broken down between substation and transmission line costs. These costs include construction materials and labor, design engineering and AFUDC (allowance for funds used during construction).

Table 5.4-6. Comparison of Installation Costs by Route.

ROUTE	LENGTH	TRANSMISSION COST	SUBSTATION COST	TOTAL COST
1 (ABDEF)	32.0	$1,865,600	$4,222,900	$6,088,500
2 (ABCDEF)	36.5	2,127,950	4,222,900	6,351,000
3 (ABCEF)	35.5	2,069,650	4,222,900	6,293,000
4 (GF)	41.5	2,419,500	4,646,400	7,066,000

As can be seen, Route No. 1 is preferred in terms of installation costs--it is over $200,000 less expensive than the next alternative.

5.4.4.2 Operating Characteristics Comparison

New calculations for each of the four routes under consideration in Phase I have not been performed. Because line losses and voltage drops are a function of line length,

the shorter line (Route 1) is preferable. Calculations contained in Exhibit B apply to the comparison of Routes No. 1, No. 2 or No. 3 versus Route No. 4.

5.4.4.3 Environmental Impacts

5.4.4.3.1 Natural Resource Impact Comparison

None of the four routes traverse natural resource exclusion areas; the majority of avoidance areas crossed are in low impact areas. The only moderate impact areas crossed are waterfowl areas close to Routes No. 2, No. 3 and No. 4.

Only those resources identified as impacted are noted, and the disciplines are not weighted relative to each other. A subjective relative importance index was developed within each discipline to depict, on a scale of one through 10, the magnitude of impact. This index is shown in individual route rating tables contained in the following subsections.

- Geology and Hydrology

The geology and hydrology route rating is shown in Table 5.4-7.

Table 5.4-7. Route Rating Based on Geologic and Hydrologic Criteria.

ROUTE	APPROXIMATE MILES	CLASS OF IMPACT	RELATIVE IMPORTANCE INDEX	RATING[a]
1 (ABDEF)	6.5	Low Impact	2	1
2 (ABCDEF)	11.0	Low Impact	2	2.5
3 (ABCEF)	11.0	Low Impact	2	2.5
4 (GF)	14.0	Low Impact	2	4

[a] 1 = least impact; 4 = greatest impact.

- ## Soils

Soils were evaluated using the USDA Forest Service landtype suitability classification (USDA, Forest Service, 1976a). Landtype suitability M6 and P6 were evaluated as having a low impact potential. These mapping units are based entirely on features visible on aerial photography or contour maps and available soils, geologic and climatic maps.

Table 5.4-8 shows the ranking for the routes.

Table 5.4-8. Route Rating Based on Soils Criteria.

ROUTE	APPROXIMATE MILES CROSSED	CLASS OF IMPACT	RELATIVE IMPORTANCE INDEX	RATING[a]
1 (ABDEF)	22.0	Low Impact	2	4
2 (ABCDEF)	9.5	Low Impact	2	2.5
3 (ABCEF)	9.5	Low Impact	2	2.5
4 (GF)	5.5	Low Impact	2	1

a = least impact; 4 = greatest impact.

- ## Water Quality and Aquatic Biota

Route No. 4 has the most potential impact -- it crosses three Class B-1 streams which may exceed water quality standards and/or be subject to streambank erosion or dewatering. Two of these are also Class IV fishery streams. Routes No. 2 and No. 3 cross or parallel two Class B-1 streams which may exceed water quality standards and/or be subject to streambank erosion or dewatering. One of these streams is also a Class IV fishery resource. Route No. 1 crosses one

Class B-1 stream which may exceed water quality standards and is also a Class IV fishery resource. Table 5.4-9 summarizes these findings.

Table 5.4-9. Route Rating Based on Water Quality and Aquatic Biology Criteria.

ROUTE	STREAMS CROSSED	CLASS OF IMPACT	RELATIVE IMPORTANCE INDEX	RATING[a]
1 (ABDEF)	1	Low Impact	2	1
2 (ABCDEF)	2	Low Impact	2	2.5
3 (ABCEF)	2	Low Impact	2	2.5
4 (GF)	3	Low Impact	2	4

a = least impact; 4 = greatest impact.

- <u>Wildlife</u>

Waterfowl concentration areas and deer winter range were the primary wildlife concerns for siting the transmission line. The waterfowl concentration areas were evaluated as having a moderate impact, and the deer winter range as having a low impact. Table 5.4-10 shows the rating of each route.

Table 5.4-10. Route Rating Based on Wildlife Criteria.

ROUTE	APPROXIMATE MILES CROSSED	CLASS OF IMPACT	RELATIVE IMPORTANCE INDEX	RATING[a]
1 (ABDEF)	15.0	Low Impact	1	2
2 (ABCDEF)	5.0	Low Impact Mod Impact	4	3
3 (ABCEF)	7.0	Low Impact Mod Impact	4	4
4 (GF)	3.0	Low Impact	3	1

a = least impact; 4 = greatest impact.

- Integration of Natural Resource Impacts

The alternative routes considered by the Applicant for providing additional power to Central Montana were evaluated and rated in terms of the potential impact to each natural resource discipline. Table 5.4-11 is an overall natural resource rating of each route based on the sum of ratings assigned for each discipline. (Thus, each discipline is implicitly given equal weight). Overall, the routes do not differ by a large margin--Routes No. 2, No. 3 and No. 4 are rated third, fourth and second, respectively, while Route No. 1 has the lowest rating; i.e., the least potential impact to the environment. Route No. 1 is thus considered the environmentally preferred route.

Table 5.4-11. Integration of Natural Resources Route Impacts.

DISCIPLINE	ROUTE NO. 1 (ABDEF)	ROUTE NO. 2 (ABCDEF)	ROUTE NO. 3 (ABCEF)	ROUTE NO. 4 (GF)
Geology	1	2.5	2.5	4
Soils	4	2.5	2.5	1
Water Quality & Aquatic Biota	1	2.5	2.5	4
Wildlife	2	3	4	1
TOTALS	8.0	10.5	11.5	10.0
Resulting Choice Ranking	1	3	4	2

5.4.4.3.2 Socioeconomic Impact

Socioeconomic comparison of the four routes is based on comparative land use impacts and visual resource impacts. Routes No. 1, No. 2, and No. 3 are also compared for communication impacts.

The comparison of land use impact is primarily based on evaluation of the reference centerlines rather than the two-mile wide routes.

- Land Use

The impact of a transmission line on land use will be in terms of its physical development and presence. The major impacts will be on agricultural lands, either range or cultivated.

Short-term impacts from construction activities, including access road development, may result in productivity loss.

Construction activities may also obstruct efficient operation of equipment used on cultivated land or disrupt range rotation systems.

The long-term impact of a transmission line will be the removal of land from production; centerline selection will determine the exact amount of productive land lost. There may also be some long-term restrictions on mechanical treatment of cropland and line maintenance may cause occasional crop damage.

All four routes have Minuteman missile silos/command centers, airfields, utility or transportation corridors, and human settlements within their two-mile corridors. The only resource quantified to differentiate a preferred route is the amount of cultivated land crossed and potentially taken out of production by a transmission line.

Route No. 1 crosses the least cultivated land and does not pass close to mechanical irrigation systems. Based on this, Route No. 1 is designated as the preferred alternative.

Agricultural land use impacts for the four routes compared below are based on the evaluation of the reference centerlines. Deviations which might allow improved placement along fencelines, roadways or across stretches of cultivated land narrow enough to straddle with a single span of conductor are not considered. A more refined centerline placement, which incorporates these improvements where available, is presented in Exhibit H (Vol. III).

Route No. 1

Route No. 1 passes through about 14 miles of dry cropland and 18 miles of rangeland. Other than Judith Gap, this option does not pass near residential developments (six homes or more); it does encounter intermittent farm or ranch establishments.

There is one air field within one-half mile and another within one mile of the Route No. 1 reference centerline. Route No. 1 comes within one-quarter mile, one-half mile and one mile of missile silos.

Route No. 2

Route No. 2 passes through 31.5 miles of cultivated land (including one center pivot irrigation system), 5 miles of rangeland, and encounters the communities of Judith Gap, Garniell, Straw, and Sipple as well as numerous farm or ranch establishments.

The route comes within one mile and one-half mile of an airfield; it passes to within one-half mile of one missile site and to within one mile of four missile silos/command centers.

Route No. 3

Route No. 3 land use is similar to Route No. 2; it also passes near the community of Moore and to within one-half mile of three airfields.

Route No. 4

Route No. 4 passes through about 26 miles of cultivated land and 7 miles of rangeland; there are numerous mechanical irrigation systems in the vicinity of this route.

Route No. 4 passes near the community of Hobson and a few scattered farm and ranch establishments. There are two missile silos within one-half mile, and one silo within one mile of the route which also passes within one mile of an airfield.

- Visual Resources

The comparison of the visual resources of the four routes was based on consideration of the scenic character of the landscape and the visibility of a 100-kV transmission line. The scenic character refers to landform, vegetative pattern, color, presence of water, the scarcity of one or more observed elements in the view, and cultural modifications made to the landscape; visibility refers to whether an object is generally seen and, if seen, whether it is observable in the fore-, middle, or background by many or few people, from single, or multiple vantage points. Consideration was also given to the potential for centerline mitigation of the line.

Route No. 1

The visual character of Route No. 1 is quite variable, but generally ranges from moderate to high. While there is nothing particularly unique or distinctive about the area given the nature of the visual resources in that part of the state, the route does pass in close proximity to the Big Snowy Mountains.

Route No. 1 would be seen by the fewest people because it is distant from all main transportation corridors, there are few residences in the vicinity, and it is generally inaccessible. The option passes through a mixture of topographic relief and could be effectively mitigated by absorption, distance and screening.

Route No. 2

The visual character of Route No. 2 is rated as low due mostly to the extensive development of the area along the southern portion. Toward the north end of Route No. 2 the visual quality of the area is considered moderate--the route parallels Highway 191 and is highly visible to motorists as well as to the many residences along the route. Centerline mitigation would be difficult along this route because of the constraints of following the existing right-of-way; mitigation would also be difficult as most of the route traverses flat, open topography.

Route No. 3

Route No. 3 is identical to Route No. 2 until they split about 2.5 miles southwest of the town of Moore; here Route No. 3 follows a railroad right-of-way to Moore, then turns east until it joins with Route No. 1.

The visual character of Route No. 3 is similar to Route No. 2 except it is rated as low over its entire length. The potential for mitigation is also low; Route No. 3 would be visible to the greatest number of people because of its proximity to Highway 191 and residential development.

Route No. 4

The visual quality of Route No. 4 is relatively low because of human modification and the undistinguished nature of the landscape. For virtually its entire length, Route No. 4 crosses open flat ground; a line located there would be visible for long distances. The route is situated along an existing utility corridor, negating the potential for centerline mitigation.

Summary of Visual Analysis

Based on data from the Phase II visual analysis, Route No. 1 appears to be most favorable. This route would be seen by the fewest people; although a short portion of it has high scenic qualities, it has diverse landscape which provides an opportunity to mitigate impacts.

The other three routes have lower scenic qualities, yet are highly visible and offer virtually no potential for mitigation of impact because the reference centerlines are sited along existing rights-of-way.

- Impacts Upon Communications Systems

Analysis of communications impacts compared Routes No. 1, No. 2, and No. 3 only. The results are compiled in Supplemental Report No. 4 and are summarized in Table 5.4-12.

Table 5.4-12. Summary of Communications Impacts By Route.

Medium	ROUTE NO. 1	2	3
AM Radio	2 houses with problems	14-16 houses with problems	14-16 houses with problems
TV	1 house with problem	7 houses with minor problem	7 houses with minor problem
FM Radio	1 house with minor problem	1 house with problem	small problems

5.4.4.3.3 Prehistoric, Historic and Paleontological Resources

- Route No. 1 [See page 53 for limitations]

Within Route No. 1 are eight sites eligible for the National Register of Historic Places--two sites (historic granaries) are classified as non-avoidance; the other six have the potential for moderate impact and are designated avoidance areas. Because their significance partially depends on site setting, these sites may be indirectly impacted by visual intrusion of the transmission line. Four sites are historic homestead/farm complexes; the town of Glengarry may be eligible as a historic district, and the Rock Creek School is probably eligible as a historic country school. Excellent opportunity exists to avoid or mitigate impact at the centerline selection stage.

Two sites within the viewshed are classified as avoidance areas: Judith Gap may be eligible as a historic district, and the Beaver Creek School may be eligible as a historic rural school. In a generic sense, both are vulnerable to visual intrusion upon site setting; however, cartographic

analysis indicates the presence of existing modern intrusions may have already compromised the integrity of those site settings. Field inspection is necessary to verify the potential impact.

- Route No. 2 [See page 53 for limitations]

Route No. 2 contains nine potentially eligible sites; three have been classified non-avoidance. The town of Garniel is probably not eligible as a historic district, but individual buildings may be eligible due to architectural values. The other two eligible non-avoidance sites are a historic barn and granaries. Five of the avoidance sites are homestead/ farm complexes; the potential eligibility of a sixth homestead within the route has not been determined. The sixth avoidance site is the town of Glengarry, which was founded near the turn of the century and may be eligible as a historic district. The homesteads, farms, and town all obtain part of their significance from site setting, which may be indirectly impacted by visual intrusion of the transmission line. Excellent opportunity exists to avoid or mitigate impact at the centerline selection stage.

Four sites within the viewshed are classified as avoidance areas: Judith Gap may be eligible as a historic district, and two historic rural schools and a farm complex may also be eligible. In a generic sense, all are vulnerable to visual intrusion upon site setting; however, cartographic analysis indicates the presense of existing modern intrusions may have already compromised the integrity of those site settings. Field verification of site integrity is necessary to reach a determination.

- <u>Route No. 3</u> [See page 53 for limitations]

Route No. 3 contains nine potentially eligible sites, three of which have been classified as non-avoidance areas. The towns of Garniel and Moore are probably not eligible as historic districts, but individual buildings within the towns are likely eligible because of architectural values. The other eligible non-avoidance site is a historic granaries site. The avoidance areas are the same as for Route No. 2: five homestead/farm complexes and the town of Glengarry, with the same excellent opportunity for impact avoidance or mitigation at the centerline selection stage. The viewshed findings are also the same: four avoidance sites including Judith Gap, two historic rural schools and a farm house. The integrity of these site settings may have already been compromised.

- <u>Route No. 4</u>

Route No. 4 contains seven potentially eligible sites, one of which has been classified as a non-avoidance area. The town of Moccasin is probably not eligible as a historic district, but individual buildings are likely eligible based on architectural values. Like Routes No. 2 and No. 3, five of the avoidance areas are homestead/farm complexes and one is the town of Glengarry. There are no eligible sites within the Route No. 4 viewshed.

5.4.4.3.4 <u>Route Comparisons</u> [See page 53 for limitations]

Table 5.4.-13 summarizes the impact analysis for all route alternatives. Each route contains six sites categorized as avoidance areas; Site TFR6 is common to all routes. Route No. 1 contains two avoidance areas within its viewshed, Routes No. 2 and No. 3 each contain four, and Route No. 4 has

Table 5.4-13. Route Comparison Based on Cultural Resource Criteria [See page 53 for limitations].

ROUTE	AVOIDANCE	ELIGIBLE NON-AVOIDANCE	INELIGIBLE NON-AVOIDANCE	UNDETERMINED	VIEWSHED AVOIDANCE	VIEWSHED ELIGIBLE NON-AVOIDANCE	VIEWSHED INELIGIBLE NON-AVOIDANCE
1 (ABDEF)	6	2	3	0	2	0	4
2 (ABCDEF)	6	3	3	1	4	0	3
3 (ABCEF)	6	3	3	0	4	0	3
4 (GF)	6	1	3	0	0	0	3

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none. The disparity between these figures is insufficient for comparative purposes--no route can be identified as preferable because of relatively less impact to prehistoric, historic, or paleontological resources.

5.4.5 Choice of Overall Preferred Route

Any comparison of routes is handicapped by several problems. One problem is the variability of data bases between resources. Another problem is comparative resource values are not easily measured even when resources are measurable and thus values are hard to compare (are ducks more valuable than historic sites, and if so, by how much?). Finally, there is the problem of estimating probability of impact within a useable range (can we say, with confidence, a line built along a particular centerline will kill between 20 and 25 ducks per year, or is 0 to 100 the best we can do?).

A great deal has been written about these and other problems of route selection. However, the use of a highly sophisticated selection methodology is not warranted in choosing between the four routes evaluated above because: 1) the expected environmental impacts are minor for all four routes, and 2) where real differences expected in environmental impacts exist, Route No. 1 is preferred. In addition, Route No. 1 is strongly preferred on the basis of both installation costs and operating characteristics.

CITATIONS

C I T A T I O N S

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